THE MARINE REVIEW

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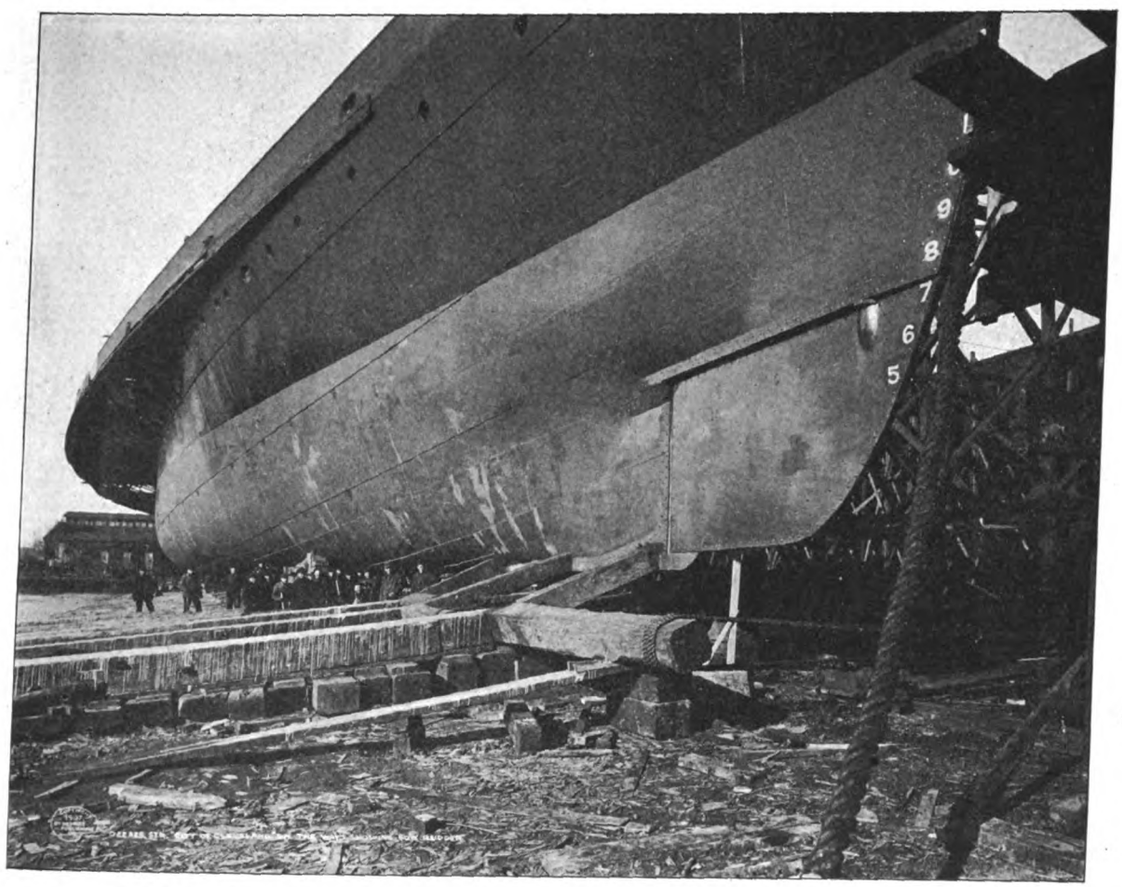
ABANDONS TURBINES.

The steam yacht Revolution, owned by Mr. F. Augustus Heinze, the well-known copper king of Larchmont yacht club, is now at the works of the Gas Engine & Power Co. and Charles L. Seabury & Co., Consolidated, Morris Heights, New York, this company having been awarded the contract to remove the two turbine engines and boilers that are now in the boat, and replace them with one Seabury triple-expansion engine, with cylinders 13½, 21 and 30 in. by 21-in. stroke, and two new Seabury patent safety water-tube boilers of latest design. The vessel will be hauled out at once, and the stern changed, so as to adapt the hull as a single screw craft. All this work is to be completed, ready for early delivery in the spring. The engine is a duplicate of those now installed in H. H. Rogers' celebrated steam yacht Kanawha, the best known of Seabury's design, and the winner of the Lysistrata cup, defeating the Noma in 1903, and the Haouli in 1904, over ocean courses. The Revolution was built by the Seabury company, from designs of Charles L. Seabury, in 1901 for the Curtis Turbine Engine Co., and fitted with Curtis turbines, manufactured by the Curtis company. The yacht was purchased by Mr. Heinze in the spring of 1905, and used by him last summer, but the turbines were found altogether too extravagant on fuel, for yacht service; hence the change.



BOW VIEW OF THE NEW STEAMER CITY OF CLEVELAND ON THE STOCKS, SHOWING BOW RUDDER.

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The same space will be used for the new reciprocating engine and Seabury boilers as was used for the turbine plant, excepting that the coal bunkers capacity will be considerably increased. The weight of the new power is less than the other engines and only one-half as much condensing surface will be used, while the speed will be fully as much, if not more than before.

The Revolution is of steel construction, 177 ft. over all, 140 ft. water line, 17½ ft. beam, 11 ft. 3 in. depth, 7 ft. 6 in. draught, flush deck, schooner rigged, with large deck house forward, used as dining saloon, with bridge on the top of same, and a large after deck house, used as social hall.

LAKE LAUNDRIES.

That the owners of lake laundries at the lower end of the route will have to look to their laurels is evident from the fact that T. H. Crinnian and Capt. Frank Root, of the Sault, made their appearance in Cleveland last week to carry on an active campaign for laundry contracts from the local owners. The company both men are connected with is the Soo Shirt Co., and the Troy Steam Laundry, a dual concern, of which they are president and vice president, respectively.

"We employ 125 hands in our plant," declared Mr. Crinnian. "We have two launches on the river to meet boats at either the American or Canadian locks, and we run a day and night service on the locks. To all of our customers, we also deliver the mail. Our facilities enable us to take care of a boat in four hours. Our laundry goes through Lake Superior's crystal water and is far removed from dirt and grime."

Mr. Crinnian started in on the laundry considering it as a side issue. He is beginning to think it a big business, but he is also interested in saw mills and the lumber business. Capt. Root is local manager for the Great Lakes Towing Co., at the Sault The other officers of the company are R. F. Andrus, secretary-treasurer, and P. C. McGowan, general manager.

PORT OF LORAIN.

Lorain will become one of the most important ports on Lake Erie if the city carries out the proposed river improvements now outlined. Black river is almost as bad as the Cuyahoga for bends, but many of the sharpest have already been dredged away and there is a vast amount of dredging yet to complete. When all is finished, the largest boat on the lakes will be able to come in and wind. This is something which can not now be done at Buffalo.

There is a cluster of piles in the river below the Erie street bridge on the east side, which mars the enterprise and ambitious plans of some of the citizens. They are located at the bend just about abreast the B. & O. McMyler car dump and it would be a hard proposition for a large freighter to come in with a boat loading at the car dump. Strong efforts have been made to get the piles out, but nothing has been done yet.

According to unofficial plans, it is proposed to straighten the river above the plant of the National Tube Co., so that the river frontage may be utilized by the several railroads which are either projected or are building into Lorain. If this is ever done, Lorain will have a clearer stretch of river than Cleveland.

The new dry dock, known as No. 2, of the American Ship Building Co., makes things loom up differently than last year. It is so situated that boats of any practical length can be launched into it from either side. Two more berths are allowed on either side of the slip, so the Lorain plant has four shipbuilding berths.

CAPT. E. O. WHITNEY.

Capt. E. O. Whitney is known as the most expert "Ciscoe Chaser" on

CAPT. E. O. WHITNEY, MASTER STEAMER JOHN ERICSSON.

the lakes, but he has also become famous for another reason—good nature. It might be said, in fact, that he has sailed his way into the hearts of his friends by spreading sunshine wherever he goes. The captain claims Henderson, N. Y., as his home, but he is known around the lakes as well as he is there. Capt. Ed. belongs to the new type of lake mariners who endear themselves to their crew by fair and humane treatment. Capt. Whitney started sailing on the steamer Missoula in 1890 as porter. He was second mate and mate on the Pioneer, sailing on her five years. In 1900, he was appointed as master of the Mesaba. Since then, he has sailed the Bartlett, Cort, Gilbert and Ericsson. This fall, he was changed from the Ericsson to the Samuel F. B. Morse.

J. W. WATROUS.

J. W. Watrous, of Ashtabula, is one of the hustling young businessmen at

J. W. WATROUS.

that port. He is a direct descendant of pioneers who helped settle the town about one hundred years ago, and his grand uncle was a forwarding agent in the early passenger boat days at the harbor. Mr. Watrous is district manager of the Aetna Life & Accident Insurance Co.

Mr. J. C. Evans announces that the new package freighter building for the Anchor line will be named Wissahickon. William Carmichael, of Collingwood, Ont., bought the old package freighter of that name.

The package freight steamers building for the Rutland Transit Co. at the Ecorse yard of the Great Lakes Engineering Works will be named Burlington and Bennington. The package freighter building at this yard for the Western Transit Co. of Buffalo will be named Rochester.

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AVERAGE LAKE FREIGHTS.

There is herewith appended the usual annual summary of lake freights for the season of 1906. Further evidence is given in the tables, of the tendency of the daily or wild rate to work out at the end of the season at approximately the contract rate. Ore contracts for 1906 were made before the year opened, when the shipping had practically sold all the ore they cared to deliver. The rates were based upon 1905 figures being 75 cents from the head of the lakes, 70 cents from Marquette, and 60 cents from Escanaba. Coal rates were established at 30 cents to Duluth and 40 cents to Milwaukee, and held to that figure until August 7, when they advanced 10 cents. This rate was maintained until late in November, when it advanced to 60, and later to 75 cents, $1 being paid on a few cargoes. Navigation opened on April 14, and continued without sensible interruption until Dec. 12. The different summaries of average rates are as follows:

AVERAGE FREIGHT RATE ON IRON ORE PER GROSS TON FROM PORTS NAMED TO OHIO PORTS—TABLE COVERING WILD AND CONTRACT RATES FOR TWENTY YEARS PAST.

	Escanaba.		Marquette		Ashland and other ports at the head of Lake Superior.	
	Wild or daily rate.	Contract rate.	Wild or daily rate.	Contract rate.	Wild or daily rate.	Contract rate.
1887	1 50	1 40	1 87	1 63	2 23	2 00
1888	1 05	90	1 30	1 15	1 43	1 25
1889	1 01	1 00	1 19	1 10	1 34	1 25
1890	89	1 10	1 07	1 25	1 17	1 35
1891	84	65	1 02	90	1 11	1 00
1892	74	1 00	98	1 15	1 15	1 25
1893	56	85	71	1 00	77	1 00
1894	46	60	60	80	78	80
1895	73	55	92	75	1 13	80
1896	52	70	66	95	77	1 05
1897	45	45	55	65	57	70
1898	51	45	60	60	62	60
1899	95	50	1 08	60	1 29½	60
1900	69½	1 00	78½	1 10	84½	1 25
1901	64	60	79	70	89	80
1902	59	60	66	70	77	75
1903	61	65	72	75	81	85
1904	53½	55	62	60	70	70
1905	61	60	70	70	77	75
1906	60	60	70	70	75.55	75
1898	28	26½	23	28½	28½	
1899	69	58	45½	66½	67	
1900	45	40	40	45	43½	
1901	49	46	38	48½	48	
1902	46½	41½	34½	46½	42	
1903	50½	45	41½	50½	46	
1904	47	40	37	45½	47	
1905	46½	41½	33½	42	41½	
1906	46	42	35	42	42	
Average, for ten years	45½	41	35	44½	43½	

Chicago rate about same as Milwaukee.
Coal of all kinds shipped in net tons and handled without charge to vessel.

AVERAGE DAILY RATES OF FREIGHT ON THE GREAT LAKES.

	1906 cents	1905 cents	1904 cents
Iron ore, Escanaba to Ohio ports, gross ton	60.	60.75	53.6
Iron ore, head of Lake Superior to Ohio ports, gross ton	75.55	76.875	70.3
Iron ore, Marquette to Ohio ports, gross ton	70.	70.	62.4
Wheat, Chicago to Buffalo, bushel	1.7223	1.6719	1.3
Wheat, Duluth to Buffalo, bushel	2.1959	2.315	1.8
Soft coal, Ohio ports to Milwaukee, net ton	46.05	46.525	47.4
Soft coal, Ohio ports to Duluth, net ton	34.85	33.5	37.1
Soft coal, Ohio ports to Portage, net ton	41.97	35.3	35.6
Soft coal, Ohio ports to Manitowoc, net ton	41.97	41.525	40.6
Soft coal, Ohio ports to Sheboygan, net ton	41.97	41.525	40.6
Soft coal, Ohio ports to Green Bay, net ton	41.97	42.425	45.6
Soft coal, Ohio ports to Escanaba, net ton	41.97	41.525	40.6
Hard coal, Buffalo to Milwaukee, net ton	45.38	44.575	43.4
Hard coal, Buffalo to Chicago, net ton	46.20	44.575	43.4
Hard coal, Buffalo to Duluth, net ton	35.19	33.05	33.9
Lumber, head of the lakes to Ohio ports	271.	245.375	254.0

AVERAGE DAILY FREIGHT RATES, TEN YEARS ENDING WITH 1906.

	Cents.
Iron ore, head of Lake Superior to Ohio ports, gross ton	80
Iron ore, Marquette to Ohio ports, gross ton	72
Iron ore, Escanaba to Ohio ports, gross ton	62
Soft coal, Ohio ports to Milwaukee, net ton	45½
Soft coal, Ohio ports to Duluth, net ton	35
Hard coal, Buffalo to Chicago, net ton	45
Hard coal, Buffalo to Duluth, net ton	35
Wheat, Chicago to Buffalo, bushel	1.66
Wheat, Duluth to Buffalo, bushel	2.12
Lumber, head of the lakes to Ohio ports	2.44

Charge to vessels in 1906 for unloading iron ore was 20 cents per ton. The wooden vessels that required trimming paid an additional charge of about 3 cents per ton for that service.

Average ore rates for the entire period of twenty years: Escanaba, contract 73½ cents, wild 72 cents; Marquette, contract 89 cents, wild 87½ cents; Ashland and other ports at the head of Lake Superior, contract 97½ cents, wild 99½ cents.

Average for past ten years: Escanaba, contract 60 cents, wild 62 cents; Marquette, contract 71 cents, wild 72 cents; Ashland and other ports at the head of Lake Superior, contract 77½ cents, wild 80 cents.

AVERAGE OF DAILY LAKE FREIGHT RATES ON HARD COAL FROM BUFFALO TO CHICAGO, MILWAUKEE AND DULUTH DURING TEN YEARS PAST.

Year.	Chicago. Cents.	Duluth. Cents.
1897	29	26
1898	28	23
1899	73	49½
1900	48	39½
1901	50	38
1902	42	33
1903	48	38
1904	43	34
1905	44	34
1906	46	35
Average for ten years	45	35

Rate to Milwaukee practically the same as to Chicago.
Hard coal is net tons and is handled without charge to vessel.

LAKE FREIGHT RATES ON WHEAT, DULUTH TO BUFFALO.

Year.	Rate cts.	Year.	Rate cts.
1906	2.19		
1905	2.31	1894	1¼@3
1904	1.81	1893	1¼@3½
1903	1.6	1892	2¼@4
1902	1.9	1891	1¾@9½
1901	2.3	1890	2 @5
1900	2.0	1889	2 @5
1899	3.6	1888	2 @5
1898	1.8	1887	2 @8
1897	1.75	1886	3¼@8
1896	2.12		
1895	3.50		

Figures for ten years past average of daily rates for full season; previous to 1895 rates given are highest and lowest of the year.

AVERAGE OF DAILY RATES ON SOFT COAL FROM OHIO PORTS TO MILWAUKEE, ESCANABA, DULUTH, GREEN BAY AND MANITOWOC.

Year.	Milwaukee. Cents.	Escanaba. Cents.	Duluth. Cents.	Green Bay. Cents.	Manitowoc. Cents.
1897	28½	29½	26	30	31

AVERAGE RATES ON WHEAT PER BUSHEL BY LAKE FROM CHICAGO TO BUFFALO.

Year.	Cents.	Year.	Cents.	Year.	Cents.
1860	9.89	1875	3.42	1890	1.96
1861	11.53	1876	2.90	1891	2.38
1862	10.49	1877	3.72	1892	2.19
1863	7.51	1878	3.07	1893	1.66
1864	9.58	1879	4.74	1894	1.37
1865	9.78	1880	5.76	1895	1.97
1866	12.34	1881	3.44	1896	1.70
1867	6.67	1882	2.50	1897	1.56
1868	7.14	1883	3.41	1898	1.53
1869	6.81	1884	2.18	1899	2.71
1870	5.88	1885	2.02	1900	1.79
1871	7.62	1886	3.68	1901	1.42
1872	11.46	1887	4.13	1902	1.51
1873	7.62	1888	2.56	1903	1.41
1874	4.03	1889	2.51	1904	1.32
				1905	1.67
				1906	1.72

Averages for 47 years, 4.43

Charges to vessels for shoveling, trimming and tallying weights of grain amounted to $4.12½ per 1,000 bushels in 1906.

AVERAGE LUMBER RATES, DULUTH TO LAKE ERIE PORTS.

Year.	Rate per M.	Year.	Rate per M.
1906	$2.71		
1905	2.45	1900	$2.33
1904	2.54	1899	3.08
1903	2.57	1898	1.78
1902	2.54	1897	1.58
1901	2.66		

BOOK REVIEWS.

The Marine Steam Turbine, by J. W. Sothern, M. I. E. S. 2nd edition. (Whittaker & Co., London. 1906. Price, 6 shillings net.)

This book, the author of which is a practical engineer and draftsman, also principal of Sothern's Marine Engineering College, Scotland, has been written for the use of marine engineers and those anxious to obtain practical information regarding the Parsons marine steam turbine.

The subject is very fully dealt with, the author illustrating the text with many original sketches made from working parts of turbines actually under construction, and numerous photographs of turbines now in active service. The machinery of the Allan liner Victorian, the Channel steamer Viper, and the Cunard liner Carmania, are fully described, the dimensions and arrangement of the two express steamers now under construction for the Cunard line, being also given.

The illustrations are clear and well designed, and are of much value in following the text. Much pains have also been taken to give simplicity to all descriptions, the author following up his original idea of making the book understandable to those whose knowledge of mathematical and technical matters may be limited, all unnecessary detail being avoided.

The work also contains much invaluable matter of interest to practical marine engineers, the experience gained from the past performances of turbine steamers now in service, comparative results of turbine-propelled steamers and similar steamers equipped with reciprocating engines, causes of breakdowns, etc.

The importance of the book to persons interested in the construction and operating of the marine steam turbine cannot be overestimated.

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DECISIONS AFFECTING SHIPPING INTERESTS.

The United States district court for New York has decided that the owner of a yacht who had a gas engine installed therein to be tried for thirty days, and then either accepted and paid for or returned, and who, though not accepting the engine or paying anything for it, retained and used it for a year, is not entitled to recover possession of it from the builder, to whom it was returned for repairs, without paying the purchase price.

LESSEE NOT LIABLE FOR FIRE.—The supreme court of Louisiana has decided that under a contract of lease of a pull boat to return the same at the end of the lease in good order, ordinary wear and tear accepted, and the property was destroyed by fire, the lessee is not liable where he used the usual care, and the manner in which the property was cared for received the express sanction of the owner.

LIGHTING HOLDS FOR WORKMEN.—A libellant, after cleaning up a dock returned with other laborers to a barge and went into an unlighted section of the hold, where they were to clean up ore left by the unloading machine. The men asked an employe of the vessel for lights, which it was his duty to furnish, and he promised to send them down immediately. While they were waiting for lights the libellant, without any obligation to do so, laid his shovel on an uneven pile of ore in order to attend to the lowering of a bucket, and then climbed on the pile in search of his shovel, and while groping about in the dark fell from a higher portion of the pile and was injured. The United circuit court of appeals for New York held that the vessel, being under no obligation to light that section of the hold until its representatives were notified that the men were ready to work there, was not guilty of negligence in failing to provide lights until within five or six minutes after libellant was hurt.

RULING REGARDING WAGES.—The United States district court for the state of Maine has decided that under section 4527 Revised Statutes, providing that seamen unjustly discharged before a month's service shall be entitled to a month's wages in addition to the wages earned, does not apply to seamen in the coastwise trade not signed before a shipping commissioner.

LIABILITY FOR INJURY THROUGH BREAKAGE.—The United States district court for Massachusetts holds that a vessel is liable for an injury to a seaman, resulting from the breaking of a fitting or appliance, only when those who represented her failed to exercise reasonable care to make the fitting or appliance safe, and where the breaking was due to a defect which might, with reasonable care, have been discovered and remedied.

SEAMAN'S REDRESS FOR INJURY.—A seaman was injured without his fault while in the service of a vessel, and was taken to a hospital after the completion of the voyage, at the charge of the vessel, from which he was subsequently discharged as cured. It appeared, however, that he had received other injuries than those treated, which prevented him from working, and made it necessary for him to obtain board, medical attendance, and nursing for a considerable time after his discharge. The court held that he was entitled to recover from the vessel the expense so incurred.

RIGHT TO REDUCE MATES' WAGES.—The United States district court for Massachusetts holds that the reduction of the wages of a mate after the completion of the voyage, for alleged incompetency or neglect of duty, will not be approved, where the employment was on a coasting vessel and there was opportunity to discharge him, but no action was taken by the master to that end, nor to disrate him.

SALVAGE.—In the early part of November the steel steamer I. W. Nicholas stranded in a fog on a rocky reef in the northern part of Lake Michigan, and the steamer Amazonas came to her relief in response to signals of distress. Backing near at some risk, owing to rocks on the bottom, a hawser was run from one vessel to the other, and by their united efforts the Nicholas was moved a considerable distance, when she again grounded astern. After further efforts, lasting in all four hours, the work was discontinued at the instance of the master of the Nicholas, who sent his mate by the Amazonas for a wrecking tug. Some time later a storm came on and the Nicholas was released by the efforts of the waves without injury. She was in a better position for such release by reason of the efforts of the Amazonas, and was originally in considerable peril, the weather being threatening. Under these facts the United States district court for the western district of New York held that the service performed by the Amazonas was one of salvage, and not merely of towage, although not one of a high order of merit, and that she was entitled to reimbursement for injury and damage to her equipment, and to an additional award of $800; her value with her cargo being $149,000 and that of the Nicholas $127,400. The case holds that it is not essential to the right of salvage that the services rendered should have been entirely successful, although the fact that they were not may be considered on the question of the amount of compensation.

LOSS OF CARGO FROM LEAKAGE.—The district court of New York, southern division, holds that a provision in a bill of lading that the ship owner shall not be liable for loss by leakage protects him as to all leakage, however great, unless caused by negligence, which must be shown to establish his liability.

LIABILITY OF SHIP OWNERS FOR INJURIES RECEIVED BY SEAMEN FROM OFFICERS OF THE SHIP.—The rights of seamen under the rulings of the American courts from time to time, have been extended to the mate, surgeons, stewards engineers, cooks, clerks, carpenters, firemen, deckhands, porters and chambermaids. All these classes of employees have been allowed to sue, in the admiralty, as mariners, or as persons rendering maritime services under a maritime contract. The liability of the ship owner for injuries inflicted upon the seamen by the master of the ship is very broadly stated by some of the authorities. Thus, one authority states the rule that "The owner is responsible for the direct consequences of any wrong doing of the master, which is done by him as master, in the discharge of his duty, and under the authority given him as master." Other authorities very much restrict these rules, holding that the rules applicable in determining the liabilities of ship owners for the wrongful acts of the officers of the ship are the rules of the general law of agency, or of master and servant.

LIABILITY OF OWNER FOR FAILURE OF OFFICERS TO PERFORM DUTY DUE FROM OWNER TO SEAMEN.—All the authorities agree that there are some duties to seamen which the maritime law imposes upon the ship owner, and that for the failure or neglect of the master of the ship to perform those duties the owner is liable. In the performance of those duties the master is regarded as the agent and representative of the owners, and if he neglects to perform them, his negligence is theirs. One of those duties is that of affording care and medical aid to sick and disabled seamen. When a seaman falls sick or suffers injury while engaged in the services of the ship, the owners owe the duty of rendering him such care and medical aid as the circumstances will permit, and if the master of the ship fails to perform that duty, and the seaman suffers injury from the neglect, the owners are liable for the damages suffered. In a Massachusetts case a seaman broke his leg while in the service of the ship. A few hours after the accident happened the vessel was within an hours' sail of a port at which a surgeon could have been obtained. The captain refused to go there, but proceeded to his destination, which he reached two days

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after, when the injured leg owing to unskillful treatment, was in a bad condition. The patient was compelled to remain in the hospital for a long time and to submit to several operations. The owners were held liable for the injury resulting from the captain's negligence. In another case the owners were held liable in damages for the sickness of a seaman resulting from the neglect of the master to furnish proper food and anti-scorbutics. The courts have held that the hospital service of the United States is not intended to supercede the maritime law requiring a vessel to take care of a sick or injured seaman, but is simply auxiliary to it. The owner of a vessel is responsible for the wrongful discharge, by the master, of a seaman before the expiration of his term of service, or for leaving him in a foreign port during the voyage for which he has shipped, and the measure of the damages of the seaman thus wrongfully discharged or left is an indemnity for all that he has lost and suffered.

LIABILITY FOR UNNECESSARY EXPOSURE OF SEAMAN TO DANGER.—Shipowners are bound to provide seamen with reasonable security against dangers to life and limb, and to supply them with reasonably safe appliances for the performance of their work on board ship; and if a seaman is injured through the failure of the officers of the ship to discharge this duty, the owners will be liable in damages for the injury. But a seaman cannot recover for injuries resulting from his own carelessness in executing a proper order given by the master. A servant who is ordered by a master to perform on land a dangerous service may refuse to expose himself to the peril, and quit the service. But a seaman, when on the high seas, is bound to obey the master's commands or suffer punishment for his refusal. If, therefore a seaman is ordered by the captain to do work which he knows to be dangerous, or to do work in a manner and by means which he regards as unnecessarily perilous, but nevertheless does it under protest, exercising due care to avoid injury, he will not be precluded from recovering from the owners for injuries received by him, because he did not then and there refuse to obey the master's orders and undertake to withdraw from the service.

LIABILITY OF SHIP OWNERS FOR ACTS OF OFFICERS WITHIN SCOPE OF HIS AUTHORITY.—It is a general principle of the law of master and servant that a master is liable for the wrongful act of the servant when the latter is at the time engaged in doing his master's business, and is acting within the general scope of his authority. This rule is applicable as between the owners and officers of a vessel, and the owners of a vessel are liable for injuries to the seaman caused by the negligence or unskillfulness of the master, provided the act be done within the scope of his authority as such. In a case before the federal court it appeared that the mate of a vessel, while engaged with a seaman in unloading her struck and injured him, his object in striking him being to enforce obedience to his orders or to drive him to more efficient work. It was held that the owner was liable for the *injury in personem*, in admiralty. But to render a ship owner liable for an assault by the captain upon a seaman, it must appear that in the infliction of the injury the captain was acting within the scope of his duty, and in the exercise of his control over the seaman. If the master of a ship assaults a seaman for an act of disobedience after the act has been done and the emergency has passed, he is not acting in the line of his duty, and the owner is not liable to the seaman for the injury thus inflicted upon him. The mate of a steamboat while standing on the boiler deck at night, saw a roustabout on the deck, near barrels from which some whisky had been previously stolen, and threw a pine knot which struck the roustabout, putting out one of his eyes. It was held that the owners were not liable for the injury, because the mate, at the time he committed the offense, was not acting within the scope of his employment. It was no part of his duty to act as watchman, another person being on deck acting in that capacity at the time.

OUR OCEAN PASSENGER TRADE.

BY WALTER J. BALLARD.

Commissioner of Navigation Chamberlain tells us that in 1905 the total arrivals at United States ports were 1,234,615, against 869,144 in 1882, an increase of 365,471; that the departures were 536,151, against 131,799, an increase of 404,352.

These totals classify as follows:

Arrivals.	1882.	1905.	Increase.
Immigrants	788,992	1,026,499	237,507
Americans returning	52,872	167,227	114,355
Non-immigrants	27,280	40,889	13,609
Totals	869,144	1,234,615	365,471
Departures.			
Cabin	68,856	201,208	132,352
Steerage ..	62,943	334,943	272,000
Totals ..	131,799	536,151	404,352

While the immigration movement in 1905 was 30 per cent greater than in 1882, the number of steerage passengers carried to foreign lands in 1905 was 432 per cent greater than in 1882. The number of cabin passengers who sailed from the United States in 1905 was 192 per cent greater than in 1882. These figures serve to show the increasing direct interest which American citizens have in the safety and accommodations of ocean passenger steamers.

STEAMER FOR PEOPLES LINE.

A contract has just been awarded for another new steamer for the Peoples Hudson River line between New York and Albany. The hull of the new craft will be of steel. She will be over 440 ft. in length, with over 500 staterooms, many of them in bath-room suites, and will have sleeping capacity for about 2,500 passengers. The new vessel will be in some ways similar to the very successful steamer C. W. Morse, of the same line, though of course, she will have every unique and modern feature that may present themselves to her builders during the period of her construction. She will be ready for the summer business of 1908. The hull of the vessel will be built at Camden, N. J., by the New York Ship Building Co., the engines by the W. A. Fletcher Co., of Hoboken, and the joiner work by Charles M. Englis, of Greenpoint.

There is every indication that the coming year will prove a very busy one at the great Mare Island navy yard. Immediately upon the completion of the gunboat Annapolis, work will begin on the cruiser New Orleans, with the view of having her ready for commission at an early date. Over $90,000 is to be expended on the New Orleans. Following the New Orleans there remains the Vicksburg, Wyoming, Solace and Bennington on the list of vessels upon which work has been authorized. The repairs on the Monitor Wyoming are the most extensive of these vessels.

News has just been received at San Francisco from the City of Mexico that arrangements have just been made for the establishment of a new line of steamers between Panama and Salina Cruz. Through the efforts of W. L. Vail a concession has been granted to the house of Vail, Adams & Co., by the government of Salvador for the operation of the line. It is claimed that this line may have the effect of losing the mail contracts to the Pacific Mail Steamship Co.'s line between these ports named.

The Pittsburg Steamship Co. resumed its nautical schools under the general charge of Capt. M. J. Fields.

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SAILORS' NAUTICAL SCHOOL.

That the time has come when men on the lakes are willing to go to school and learn the scientific principals of their profession to combine them with the practical experience, is shown by the accompanying half-tone, which represents Capt. Sam Gould's nautical school in active operation. The classes are being held in room No. 22 Wick block, Cleveland, and there are nineteen students at present Two sessions are held daily, the afternoon being given over to recitations and questions. There is not one man in the whole number who has not had as much practical experience as he can get without going up higher.

In times gone by, the lake man who talked navigation was virtually ostracized by his fellows, and the one who put it in practice was blackballed, figuratively speaking. But times have changed now and no matter how navigation may be considered, it is a fact that the United States inspectors at Buffalo and Cleveland, at least, have outlined the stiffest kind of a program for prospective applicants for licenses. They appear to be working on the theory that sailors can not know too much about their business.

READING FROM LEFT TO RIGHT: G. B. McDONALD CARI MORRISON, CHRIS LOWE, B. COTTRELL, FRANK GOULD, LOUIS W. NORTIMAN, FRANK JOYNER, JOHN N. PETERSON, CAPT. SAM GOULD, ALEX MOUCK, LOUIS H. FEGER, N. J. KROHN, WM. H. MACLACHLAN, SAM EMERSON, CONRAD CHRISTIANSEN, BERTRAND VROMAN, CHARLES MYERS, R. L. JONES, A. C. MORTON, JOHN LUNBACK.

THE DEVELOPMENT OF NAVAL ARCHITECTURE.

At a "talk" on the development of naval architecture by Mr. E. W. De Rusett, M. I. N. A., to the members of the Tynemouth Literary and Philosophical Society, the famous ship designer took his hearers back to the days when Volturius produced his vessel propelled with canvas paddle-wheels, and thence right down to the Cunarder Mauretania, with whose design he had been so closely associated. He referred to the names of Papin, the Frenchman, who played a part in the work; to John Allan in 1730, the first really serious attempt was made in the development of the steamship. But it was to Miller, Taylor and Symington that the greatest amount of credit is due. Bell's Comet was a wonderful craft of three to four knots speed. It took four paddles to take the three horsepower. In 1818 the first steamer was turned out to navigate the coasts of Great Britain.

The Savannah, Royal William, Sirius and Great Western were developments and used steam of three pounds per square inch. Mr. David Napier had done a great deal in his day, and ran the first Glasgow to Belfast steamer. F. B. Smith worked on the screw propeller, and his screw boat towed the paddle steamer. Hall then introduced the surface condenser, but success was retarded owing to the difficulty of making round tubes. The Great Britain was the first ship fitted with wire rigging, and was altogether a wonderful craft. Randolph Elder introduced the compound engine in 1854, thus reducing the consumption of coal from 7 lbs. to 3½ lbs. per horsepower per hour, and that had since been reduced to 1.3 lbs. Then the development was more rapid, and boilers which had to be swept out in the most primitive fashion, and which only worked at low pressures, gave way to those of 70 lbs. pressure under the

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compound system, and eventually to the present-day boilers with their very high pressures up to 220 lbs. Altogether, it took nearly a hundred years to develop the steamer, both hull and engines. This was because of the backwardness of the industries upon which engineers depended. The naval architect and marine engine builder were dependent upon others, and so were hampered. The steel necessary for the building of the Mauretania could not be produced when the Lucania was built, and in many other directions, it would have been impossible to produce a Mauretania only a very few years ago. Thus blame could not be attached to ship builders for the slow progress made in the past. It was very different now, as the rapid development of the turbine showed, for in 13 or 14 years the new system had advanced from the little Turbinia to the huge Mauretania. Today turbines for marine propulsion, constructed and on order, represent 870,000 H. P. This has been possible because of the advanced position of the allied trades.

Mr. De Rusett gave many details of the great ship building at Messrs. Swan, Hunter & Wigham Richardson, and said that the work in connection with such an undertaking could scarcely be appreciated. There had been a staff of something like 40 draughtsmen engaged for over two years on the plans of the ship, but this did not by any means represent what had been done in making drawings and calculations. Over 1,800 principal drawings had been produced, from which others had to be made. Referring to the immense boiler power, the speaker said that for every ton of coal consumed in the 25 boilers, eight tons of air was needed, and the furnaces would require about 1,000 tons a day to maintain the steam necessary for the turbines, through which 9,000 tons would pass, and act upon the 3,000,000 blades every 24 hours of steaming.

THE LEADING SHIP BUILDING DISTRICTS.

(From the Glasgow *Herald*.)

The six British districts and foreign countries which figure first as producers of tonnage are the same as those of last year, and the only alteration in their order is that Germany with its increased output steps over the Wear from fifth to fourth place. Two years ago Germany was third, but last year it fell to fifth. The Clyde, it will be seen, easily maintains its supremacy, with a tonnage and horse-power greater than those of any foreign country:

	Vessels.	Tons.	I. H. P.
The Clyde	372	598,841	606,600
United States ..	207	464,671	260,761
The Tyne	159	411,569	375,705
Germany	361	360,980	326,998
The Wear	98	334,572	222,811
Tees and Hartlepools	88	292,344	144,750

RECORD WORK BY ENGLISH BUILDERS.

The majority of the honors in the way of large individual tonnages go this year to the northeast coast of England. The American Ship Building Co., with their six yards (that at Buffalo reports having launched no vessels) have 198,535 tons to their credit; but while they cannot be denied their position at the top of the list, the work of Messrs. Swan, Hunter & Wigham Richardson is of a far more notable character. It is easily the most important and the most valuable that has ever been carried out in one year by one firm, and if we regard the American company as a "combine"—which it may in a sense be called, seeing the yards are scattered over a wide extent of country,—it is also the largest. Last year the American company, with work from each of their seven yards, had twenty-seven vessels of 136,795 tons, and Messrs. Doxford, of Sunderland, were second with twenty vessels of 86,632 tons, Messrs. Harland & Wolff third with nine vessels of 85,287 tons, Messrs. Swan, Hunter & Wigham Richardson fourth with twenty-one vessels of 74,424 tons, Messrs. Russell & Co. fifth with eighteen vessels of 71,540 tons, and Messrs. Wm. Gray & Co. sixth with nineteen vessels of 63,226 tons. In number of vessels Messrs. Swan, Hunter & Wigham Richardson and Messrs. Doxford tie for what is practically first place, with 25 vessels each, lead in the matter of tonnage by 18,178 tons. The following are the six leading firms for the year, the measurement, of course, being board of trade tons gross:

	Vessels	Tons
The American Ship Building Co. (6 yards).....	34	198,535
Swan, Hunter and Wigham Richardson	25	117,943
Wm. Doxford & Sons....	25	99,765
Harland & Wolff	11	83,238
Wm. Gray & Co.....	24	74,933
Workman, Clark & Co...	13	65,148

The Clyde, which has turned out a very much larger quantity of work than in any previous year, and much more than any other district, has, curiously enough, no individual tonnage which qualifies for a place among the first half dozen firms. There are, however, firms on the Clyde the value of whose work is far more than measurement by tonnage indicates, and who distribute much more money in wages than firms whose output is larger.

The high place taken by Messrs. Swan, Hunter & Wigham Richardson is shown in the following table, which gives the leading firms since 1890:

1906	American Ship Building Co. (6 yards).....	198,535
	Swan, Hunter & Wigham Richardson	117,943
1905	American Ship Building Co. (7 yards)	136,793
	W. Doxford & Sons	86,632
1904	Russel & Co.	73,689
1903	American Ship Building Co. (7 yards)	166,288
	Harland & Wolff	110,463
1902	American Ship Building Co. (7 yards)	132,197
	Harland & Wolff	79,497
1901	Harland & Wolff	82,262
1900	Wm. Gray & Co.....	74,191
1899	Harland & Wolff	82,634
1898	Wm. Gray & Co.	72,323
1897	Harland & Wolff	82,240
1896	Harland & Wolff	81,316
1895	Wm. Gray & Co.	63,068
1894	Harland & Wolff	65,448
1893	Harland & Wolff	65,660
1892	Harland & Wolff	68,612
1891	Harland & Wolff	64,962
1890	Russell & Co.	70,370

SHIP BUILDING IN THE UNITED KINGDOM.

From the returns completed by Lloyds register of shipping, it appears that, excluding warships, there were 481 vessels of 1,166,989 tons gross under construction in the United Kingdom at the close of the quarter ended Dec. 31, 1906. The vessels now under construction are 98,000 tons less than those which were in hand at the end of the last quarter, which itself showed a striking decrease (144,000 tons) as compared with the previous quarter. There is thus a diminution of 242,000 tons during the last six months. A somewhat similar falling off was observable in 1902, when between March and September there was a decrease of 240,000 tons, with this exception, however, there has been no such reduction since 1884, when the tonnage under construction fell from 789,957 tons to 480,579 tons within a period of six months.

The Consolidated Steamship Lines (the Eastern Steamship Co., Metropolitan Steamship Co., Clyde Steamship Co., Mallory Line, Peoples' Line and Citizens' Line), announce the removal of offices of the passenger traffic manager and general passenger agent from Pier 32, North River, to 290 Broadway, New York.

The freighter Louisiana will go into dry dock for caulking and the freighter John W. Moore will have new hatch covers installed on her this winter.

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THE NEW SUBSIDY BILL.

The new mail subsidy bill, as reported by the house merchant marine and fisheries committee, will cause the establishment of four new lines of American steamships, and retain under the American flag three lines now in operation on the Pacific. In all cases the ships must be of sixteen knots' speed, with the single exception of the line proposed from New Orleans to Colon, which must be of ships of 14 knots' speed. The line to Brazil will require four new ships, that to Argentina five, the New Orleans-Colon line two, from Puget Sound to the Orient four, from San Francisco to the Orient three, from Pacific coast ports to Chile five, and from San Francisco to Australia one, making a total of twenty-four new ships needed. In fact, it is thought that the service to Brazil and to Argentina will require each one more ship than is named above, making a total of from 24 to 26 new steamships required, all of sixteen knots' speed, but two.

The seven lines of American steamships thus provided for will receive $3,750,000 a year in mail subsidies, if they each make fortnightly sailings and less than half of that sum, if they only make monthly sailings. In the beginning, very likely, some of the new lines will inaugurate only a monthly service, changing it to a fortnightly service as soon as it can be made profitable.

The government now receives $3,000,000 more from sea postage than it expends for ocean mail transportation. It also expends about $300,000 a year now for mail carriage on the routes covered by the seven lines. This places at the disposal of the government, now, $3,300,000 for a service the maximum cost of which, if now in operation rendering the maximum service provided, would not cost more than $3,750,000. But as, at best, these new lines cannot be established inside of two or three years, by that time it is probable that the sea postage collected will more than defray all of the expense, even should the maximum amount be spent for the maximum service specified in the bill. Thus the mails will themselves furnish the money with which to pay for the cost of their carriage, without taxing the people of the United States a dollar.

OUR TRANS-PACIFIC LINES.

A determined and vicious effort is being made to discredit the new mail subsidy bill, on the ground that it provides "subsidy" for existing American mail lines on the Pacific. These lines, it has been alleged, were established because, as commercial ventures they seemed to offer a profit, and for the government to now step in and pay them $1,600,000 mail subsidy, would be indefensible. There are three of these lines. One runs to Hawaii, Pago Pago, New Zealand and Australia, and it receives $283,000 a year under contract with our government, now. Its owners claim that they are losing money at the rate of $373,000 a year; that the line is more than $2,000,000 in debt; that it defaulted on its bonds in July last year, and was likely to in January, this year, and to be placed in the hands of a receiver, and the line discontinued. It has built up a fine and profitable trade between the United States, New Zealand and Australia, the service is of the best, and the ships make seventeen knots' speed. The passage of the pending bill would save the line from bankruptcy and discontinuance; but it even then would not save its owners from suffering a large annual loss.

The line from San Francisco to the Orient, via Hawaii, is the Pacific Mail. A majority of its stock was bought, in the open market, by the Southern Pacific Railroad Co. It is running five ships, four of which are of the most modern up-to-date type. The ships are losing money, and have not paid a dollar to their stockholders for eight years. They are in competition with a Japanese line of three steamships of inferior size and speed, but soon to be augmented with two 13,000-ton turbine steamships of high speed now building in Japan. As at present operated, the competing Japanese line receives an annual subsidy of $600,000 from the Japanese government, besides which the Japanese pay about $12 per ton construction bounty on Japanese-built steamships.

Out of Puget Sound a line of five American steamships is being operated, at a loss. It has not paid its stockholders a dollar upon their investment since they have been in operation. These five steamships, the property of the Boston Steamship Co., of Boston, Mass., are not owned by Mr. James J. Hill, as has been alleged, but are owned as described. Mr. Hill, president of the Great Northern railroad, runs his two mammoth steamships, the Dakota and the Minnesota, in conjunction with, but independent of, the Boston Steamship Co.'s boats. These ships are in competition with two subsidized lines, viz: the British line out of Vancouver, which receives $300,000 a year in subsidies for three old-fashioned ships; and the Japanese line of three steamships, which receives $330,000 a year from Japan. The Boston Steamship Co.'s ships are being run at a heavy annual loss, as are the Hill boats. Mr. Hill has said that under existing conditions he will never build another ship in the United States, and he has been quoted as threatening to place his ships under a foreign flag, or to sell them.

In addition, it has been stated, over

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and over again, that the Japanese have made attractive offers for each one of these fifteen fine American steamships in the trans-Pacific trade.

THE MARINE REVIEW holds no brief for any of our trans-Pacific lines. It would be a reasonable presumption, however, and it is worth the while of our members of congress to consider it, that if it passes a bill to establish the four new lines proposed apart from those traversing the Pacific, and cuts them out of any benefits thereunder, these three lines will disappear from under the American flag, and we shall have not one American steamship in our trade with the Orient, and with Australia. These ships have been kept on their several lines, and under the American flag, in the hope and belief that congress would deal fairly by them, eventually. If that hope is destroyed, doubtless the lines will cease to exist, at least as American lines. Is that what the people want, and is it what congress wants?

ORE SITUATION.

The predictions of the trade are that about 40,000,000 tons of ore will be moved next season, or about 3,500,000 tons more than was moved on the lakes last year. It is known that season chartering has been the heaviest in the history of lake trade, and the shippers in general have sold all the ore that they care to promise to deliver. During 1906 the Pittsburg Steamship Co., which is the lake end of the Steel Corporation, moved 11,355,000 tons of ore in its own ships. Next season it expects to move nearly 14,000,000 tons of ore in its own vessels. During 1906 it had practically little service out of the Crescent City, Manila, Mataafa, Ream, Widener, Edenborn and Ellwood. These vessels will all be in commission during 1907, together with the Cole, Phipps, Baker and Lynch, the four 600-footers now on the stocks, but upon which excellent progress is being made by the shipbuilding companies. These vessels will add over 2,000,000 tons to the carrying capacity of the company's fleet during 1907.

It is reported that altogether vessel capacity to move about 35,000,000 tons has been tied up for the coming season, including, of course, vessels operated by shippers and ore consuming companies. This would leave about 4,000,000 tons to be carried wild, provided the movement reaches 40,000,000 tons.

No chartering has been done in the coal trade as yet, but there is certain to be a good demand for coal tonnage at the opening of navigation as reports from the northwest indicate a great lack of coal there. In fact, so much difficulty was experienced during the fall months in getting coal to Lake Erie docks, that the northwest was not as well supplied as it might have been.

IRON SITUATION.

Indications pointing toward a near general activity in freight car construction featured the iron and steel market during the past week. The purchases and the inquiries for construction material, coupled with the announcement of the $100,000,000 car corporation by the Pennsylvania railroad are regarded as significant. Pig iron transactions were steady. Pittsburg sheet mills are working over time and are far behind on deliveries. Old material is the only exception to the strong market. Unfavorable weather conditions with resulting floods have temporarily clogged the working of mills in some quarters and have added another obstacle to the already severe conditions existing in railroad freight traffic.

SUBMARINE SOUND SIGNALING.

Capt. W. W. Smith, superintendent of the Pittsburg Steamship Co., and Capt. George F. Parks and Samuel C. Allen, have returned from their eastern trip filled with enthusiasm for the system of submarine signaling which they inspected on the coast. While their report has not yet been presented to President Harry Coulby, it is known to be favorable in the highest degree. Capt. Parks was much impressed with the absolute precision of the signal system. In fact, while Capt. Parks was at the indicator box on board the steamship H. F. Dimock of the Metropolitan line, and was picking up the bell of the Vinyard Sound lightship on the port bow, the course of the steamer was changed without his knowledge. Capt. Parks instantly picked up the bell on the starboard bow and was much surprised by this exhibition of the certainty with which the location could be determined. The steamer Dimock left New York at six o'clock on the morning of Jan. 11. The party approached the Corn Field Point lightship at about eleven o'clock in the morning in a thick fog. The lightship had just started the bell as they approached the steamer, picking it up at a distance of one and three-quarter miles. The next approach was the Vinyard Sound lightship which was reached about 4:30 o'clock in the afternoon. They heard this bell twenty-five minutes before passing the lightship, or at a distance of about five miles. It was here that the course of the ship was changed while Capt. Parks was at the indicator box, but he was not in the slightest degree confused as to the direction from which the sound emanated. The fog was so dense that the lightship could not at any time be seen. The Pollock Rip Shoals lightship was picked up at 10:20 P. M. The Dimock passed the lightship at about 10:58, having heard the bell for thirty-eight minutes, or at a distance of six miles. The tests were an emphatic endorsement of the efficiency of submarine sound signaling. President Coulby of the Pittsburg Steamship Co., will probably issue a report upon the subject next week.

LAUNCHING THE COLE.

The Pittsburg Steamship Co. has issued invitations to the launching of the steamer Thomas F. Cole at the Ecorse yard of the Great Lakes Engineering Works on Saturday, next. The Cole is 600 ft. over all, 580-ft. keel, 58-ft. beam and 32 ft. deep. She has thirty-six hatches, spaced 12 ft. centers. Her engines are triple-expansion with cylinders 24, 37 and 65-in. diameters by 42-in. stroke, supplied with steam from two Scotch boilers, 16 ft. in diameter and 12 ft. long, fitted with induced draft and allowed 107 lbs. pressure. This steamer is the first 600-footer to be built by the Great Lakes Engineering Works, and is also the first of the four 600-footers now building for the Pittsburg Steamship Co. for 1907 delivery to be launched. Her sisters are the Henry Phipps, building at Bay City; the Thomas Lynch, building at South Chicago, and the George F. Baker, building at West Superior.

Mr. David Croxton of the Cleveland Furnace Co., makes an excellent argument in favor of the improvement of the inner harbor of Cleveland. He points out that the ore consumed in Cleveland is infinitely worth more in actual money to the city than that shipped to other points. During the year 4,261,000 tons of ore were forwarded from the Cleveland docks, while 2,600,000 tons were consumed by the furnaces along the Cuyahoga river. Mr. Croxton's argument is that this ore is eight and one-half times as valuable to the city of Cleveland as the ore that was sent to the furnaces in the Ohio and Pennsylvania valleys. He thinks, therefore, that a generous policy should be adopted towards the improvement of the Cuyahoga river, and that its navigable channel should be greatly extended.

Extensive improvements are now in progress along the Buffalo river. The work extends about two and one-half miles up the river and counting the docks on both sides, five miles of frontage will be secured.

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Naval Architects and Marine Engineers

Discussion upon Naval Constructor R. H. M. Robinson's paper "Notes on the Development of Warship Design" was animated and was led by Prof. William Hovgaard, of the Massachusetts Institute of Technology. This paper has attracted international attention and will be published in full in THE MARINE REVIEW next week.

Capt. William Hovgaard—This paper contains so much interesting information and so many valuable suggestions that without making the discussion unduly long it is only possible to deal with the more important points contained in it. The information contained regarding the development of the American battleship is particularly valuable to one who studies and teaches the general subject of warship development. I entirely agree with the author of this paper, that the abandonment of the intermediate calibre guns in battleships is unwise or at least premature. As ships are now built, and neither the Dreadnaught nor the Michigan are exempt from this feature, they present large unprotected or lightly protected areas which are best attacked by guns of modern calibre, because such guns are sufficiently powerful for such purpose. A greater number of them can be carried on a given rate, and they have a greater rate of fire. Thus a more scattered fire and many more hits can be obtained than with a smaller number of heavy guns. The greater durability of guns of moderate calibre, as compared with guns of heavier calibre, is another point in favor of guns of intermediate calibre. The demolition of the light works of a warship is a matter of no small consequence; communication is made difficult, the working of guns may be impeded by the degree of falling masts, funnels, ventilators, etc., as well as by the fire and smoke, the draft in the furnaces may be obstructed. Fires may break out and splinters will be flying about, possibly entering through gun ports and sighting hoods into the turrets. The smoke and noise will be detrimental to the general service of the ship.

Although hand worked guns such as five, six and seven-inch calibre would in one sense be the best for this kind of work, I believe it is more profitable to go to nine or ten-inch calibre, in view of the possibility of long-range fighting, where the lighter guns would not be effective.

If we adopt a uniform battery of heavy guns, we meet difficulties in mounting more than four guns, since the broadside positions and center line positions amidships give a much smaller arc of fire than the end positions, and have other drawbacks in point of ammunition storage. These difficulties have been successfully overcome in the Michigan. Nothing could be more efficient from a purely artilleristic point of view than the gun arrangement adopted in that ship. Eight guns have here, speaking roughly, an aggregate arc of fire of 24 right angles, while, if two of the turrets had been placed on the broadside, only 20 right angles would have been obtained. Thus there is a gain of 20 per cent in this respect, and this gain is entirely on the broadside, from 45 degrees forward to 45 degrees after the beam, and this arc in fleet action is probably the most valuable. On the other hand, this arrangement by which the turrets two by two are placed closely together is not without serious objections. The barbettes nearest amidships are very high and heavy, and present a great target The two turrets taken together form a large target, far easier to hit than would be two separate turrets. Finally, there is the danger of simultaneous disablement. An example of this we had in the Battle of the Yalu, where the Chinese battleship the Ting Yuen had all her four heavy guns put out of action for a considerable time by a fire which broke out in the fore part of the ship. The guns were in this ship mounted on two turntables close together en echelon in a common barbette under the bridge. In the Michigan, conditions are of course more favorable, since there are two independent groups of guns placed far apart.

As regards interference by blast effect of the upper guns on the lower, I presume this question has been satisfactorily settled by experiment before this arrangement was decided on. The question of strength and stability in connection with this gun arrangement presents some problems which may, however, probably be overcome without great difficulties. Whether the advantages by the gun arrangement of the Michigan outweigh the objections that may be made to it, can only be definitely settled through war experience.

In discussing the speed problem there are two points which have not been touched on in the paper. Instead of using the large tube boiler in large ships a considerable gain in weight could be obtained by using small tube boilers. This has been done in Germany, where at present all warships, from torpedo boats up to battleships are going to have the same type of small tube boiler, the Schultz-Thorneycroft. Besides the saving in weight hereby effected, there are other advantages: Easier training of the personnel, interchangeability of parts and the capability of quickly raising steam. In the Danish navy, where the small tube boiler of the Thorneycroft type has been used exclusively for a number of years, there have been no difficulties, but these boilers will require, of course, somewhat more care in maintenance than the more robust large tube boilers. As an example of the capabilities of this boiler in point of raising steam quickly, I may mention that in one of the Danish armorclads steam was raised from cold water in the boilers to full power in 26 minutes, at the end of which time the ship was steaming at her full speed. This is, of course, a very great military advantage.

Another point where a gain might be made is by the use of oil fuel by mixed combustion. The United States liquid fuel board has deprecated the use of oil in this way, but as no reasons are given for this opinion, it is not possible directly to meet their objections. It is a fact, however, that this feature is now successfully introduced in the Italian, German and English navies. It is found to give a great gain in the steam-developing power of the boilers, it facilitates rapid changes in power, and the oil may be stowed without any loss in bunker space.

I agree with Mr. Robinson in his objection to excessive speed in battleships. The increase in speed should be made in a conservative manner, gradually as the means of propulsion are improved and as the size of the ships and the importance of the battery justifies such increase. In other words, the percentage weight generally devoted to propulsion in battleships should not be much exceeded in new designs. Increasing the speed of battleships in order to merge this type with that of the armored cruiser, would hardly lead to the desired results, since no absolute increase of

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speed in the battleship, however high, can remove the need for a type of still faster ships; but this question I have already dealt with in my paper of last year on the "Cruiser," so I shall not enlarge further upon it now.

As regards protection against submarine attack, Mr. Dickie suggested this morning an armor protection on the outer shell extending from the belt to the bilge keels. Now, I do not think that this would at all be effective, on the contrary I believe that it would constitute a distinct danger to the ship. Near the center of explosion of a torpedo, when this explosion takes place under water, no armor, however thick, can resist the enormous pressures created; if an armor is placed here it will in all probability be broken up and pieces of it hurled into the hold like projectiles. The energy of the explosion is with this arrangement allowed to do work, which is just what ought to be prevented. This may, it appears, be obtained by allowing the gases to expand as freely as possible, and when such expansion has taken place, we may at a certain distance from the center of explosion fit a strong, elastic and tough armor bulkhead which on account of the smaller pressures here existing will have good chances of resisting the explosion. The distance of this bulkhead from the side should, judging from experiments and from war experiences, be about 18 feet from the outer shell; the armor should be of a tough quality, similar to that used in protective decks. I have already discussed the question of submarine attacks in my paper on the "Seagoing Battleships," read before the society two years ago, and should not have come back to it here were it not for Mr. Dickey's remarks. The great beam required for this purpose may not be so detrimental to speed as might be imagined. Thus it was found by model experiments carried out by the late Mr. Froude in connection with the work of the Tuflexible committee that even a considerable increase in beam of that broad ship would not be detrimental to speed, provided the ends were made finer. An increase in beam is, moreover, highly desirable in order to give to our battleships a greater initial stability. The metacentric height which has so far been considered sufficient is 3¼ to 4¼ feet, but if we take into account the modern conditions of warfare and the experiences of the war in the east, we must admit that this metacentric height is far from sufficient in order to make the ships tolerably safe under the probable risk. Battleships of some 18,000 tons displacement should not have less than 6 to 8 feet metacentric height.

In conclusion, I wish to say a few words about the rapid increase in displacement which has taken place recently. In my paper on the "Seagoing Battleships," I have attempted to show the advantage of larger ships compared with smaller, and I have in a general way advocated large size for battleships. I have, however, also stated that I considered it in a seagoing battleship unwise to exceed that displacement which at any given time is found to be necessary and sufficient for the due performance of its work. It may not be out of place to briefly review the arguments which may be advanced against the too rapid increase in displacement: Difficulty of providing harbor and dock accommodation; increased dangers of grounding, a danger which has recently been made evident by the loss of the English battleship, the Montague. The fate of this ship may befall any ship, however large, and should be a warning against progressing too fast in the direction of an increase in size; greater probability of submarine attack due to the rapid development and general introduction in all navies of submarine boats.

For these reasons I believe, that the increase in displacement should be made in a conservative manner, only after all other and especially technical means of improvement have been exhausted, and then only if military considerations necessitate such course. By keeping the speed at a moderate figure, i. e., at the same height as battleships generally, some 19 knots, making full use of the technical resources at our disposal (turbines, small tube boilers and liquid fuel by mixed combustion), the ordinary line of battleships should not at present need to exceed 18,000 tons displacement, even if endowed with greater gun power and better protection than any battleships now afloat. We may, a few years hence, find it necessary to adopt higher speed and also greater displacements, but it is also possible that the development may take the opposite course. It is therefore safest to base our designs on existing conditions, and, by progressing cautiously, to avoid excessive expenditures on individual ships.

Mr. Spencer Miller—This is the second paper today in which the authors have referred to the subject of coaling warships at sea, both seeming to indicate that there is much to do in that problem. It is not my disposition at all to dispute what they saw, because I know only too well what they say is quite true, but it gives me a good deal of pleasure to give you the benefit of some of my experiences on this subject. It is gratifying to note that the problem of coaling warships at sea is referred to in three papers before this convention. Capt. Barny's paper, "A Modern Fleet," refers to the transferring of coal in the open sea as "the best from every theoretical point of view, but weather and other unforeseen circumstances interfere." He also says "much thought and practical ingenuity have been expended so far without perfect success on the problem of coaling ships at sea." A startling fact is brought out by Capt. Barry in which he declares that "three hours will expend all the ammunition in any ship afloat." Naval Constructor Robison says, "As to coaling at sea, it has engaged the whole attention of several experts who have solved it more or less satisfactorily. Much remains to be accomplished in this line." I have no disposition to dispute these authors, but it gives me a great deal of pleasure to be able to give at this time the results of the recent sea trials in Italy. The Royal Italian collier Sterope (375 ft. long capable of carrying 6,000 tons of coal) is fitted with a marine cableway constructed by the Temperley Transporter Co. of London. It coaled the Royal Italian cruiser (third class) Liguria (2,280 tons) in a sea in which the screws of the cruiser could be seen aboard the collier. Sixty tons per hour were actually transported, but it was demonstrated to the satisfaction of everybody that 70 to 80 tons could be transferred with certain minor improvements in the feeding of the cable way.

In the marine cable way a single carriage reciprocates between collier and warship, 400 feet distant The load must travel about 600 feet. Ton loads were transported, making complete round trips in 35 seconds; in fact the slowest round trip made was 57 seconds. Every load carried was a ton. The tension in the main cable could easily have been increased to support a 1¼ ton load. Round trips could be made in 40 seconds. A 1¼ ton load every sixty seconds equals 75 tons per hour, every 50 seconds 90 tons per hour, every 45 seconds 100 tons per hour, every 40 seconds 112 tons per hour. At the Lidgerwood's Cableway Testing Station 1¼ ton loads have been transported at 35 seconds per round trip.

I wish, however, to give emphasis to the fact that a cable way cannot

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transport any more coal than is brought to it. The Italian trials were in that particular no different from others. A common collier's winch was employed to hoist the bags of coal to the cable way. The delays caused by this winch represented more than one-quarter of the time. In the hour in which 60 tons were actually transported, account was taken of the delays caused by the winch in not getting the coal to the cableway. These delays aggregated 17 minutes out of the 60. If the Italian navy will continue to operate this marine cableway, making such alterations in the feeding arrangements as are indicated by actual experience, there is no question but that that particular machine will transport 100 tons of coal per hour. This may involve an elevated track for transporting the coal from the after hatches forward; to the end that the greatest amount of coal may be transported with the minimum of human effort.

The reason why the United States navy is behind the European navies in this problem is because they have been too busy to experiment. The first ship that was ever coaled in a heavy sea way was the U. S. S. Massachusetts. One reason why that was successfully done was because the commanding officer (the late Rear Admiral Charles Train, U. S. N.) insisted that the machines should be given a fair and sufficient trial. It is also gratifying to state that the U. S. navy department has at last seen its way clear to devote some time to reaching a conclusion in this problem. The department has imported an English machine to be tested at sea in competition with the marine railway. The U. S. collier Alexander is to be used for the purpose. The outcome will be known before this society meets again. The English machine employs a continuous moving endless rope, on which single bags weighing 200 lbs. each are transported on one branch of the endless rope. Each bag is supported in a small hook-formed carriage. In the marine cableway a single carriage is employed. If both are given fair and sufficient trails, a most valuable lesson will be learned.

Mr. John Reid—I shall perhaps be able to give you a few opinions on this paper from a different point of view. I have only had the paper in my hand since I came here, but perhaps can give you information on some of the points. I am sorry to hear a gentleman of Commander Hovgaard's standing take a retrograde position as to some of these modern methods. I hope I do not do the gentleman an injustice. I find him advocating monitors for the United States navy; the monitor, in his opinion, is practicable as a fighting machine for any purpose such as the United States navy requires. The United States, I think, must go ahead and meet anything that can be met with in any nation, and the monitor cannot do that. It must become a coast defense machine. You are wasting money in building monitors to take the place of battleships. Naval warfares are the results of action at sea. Therefore, I am rather surprised to hear Mr. Hovgaard go back to a smaller battleship, if I take him rightly, and a smaller gun; and rather give credit to what, I must say, with all respect, has been rather a trouble, I think, with your congress, cutting down the displacement of battleships and limiting them, limiting the displacement, which has done more harm. I do not hesitate to say from the Oregon upward, almost to the present day, the displacement is less than it should be with gun weight and armor carried. I do not think any one need do more than look at the photographs of your warships to see that they do not go through the water clean. They pile the water up ahead, but still make a good speed. This is largely because the displacement is limited, and it is difficult to make a good showing under a limited displacement. Capt. Hovgaard referred to the question of interior armor. The suggestion he makes is that we should design the armor from the outide, but put inside about 10 or 15 feet, or more, and run along the inside with an armor made of moderate sized plates. I do not think that will have very much effect, for if you get a blast on the side of the ship it will destroy your armor, even if it is inside.

As regards the actual size of battleships, and the tendency to go back to smaller ships and lower speeds, which is essentially due to the matter of displacement, that will result in serious complication. If Germany, or France, or Britain has 20,000 ton battleship with an enormous number of big guns on board and a speed of 21 knots, it is up to the United States to have the battleship as big or bigger and if England calls her ship the Dreadnaught, the United States must call its ship "Scared of Nothing," a very good name indeed. As regards the 8-in. gun, I have always asked why the 8-in. gun was revived in a number of old battleships, with the superimposed turrets. I have been told, as the paper confirms, that the gun has been re-introduced because it did good work in the Spanish-American war. That is a curious illustration of how precedent or tradition trammels a country so free from such things. I think it is a dangerous tendency. The whole result of the Japanese war is that the big gun must have its full weight in every ship that is built today. You must have the largest number of them, and sufficient speed, and if you have sufficient speed, you can pull off from the smaller and less powerful vessels and fire at your leisure at such range as will be necessary, such range as the 6-in. or 8-in. guns are of no possible value. These are the points I wish to raise, and I am very glad to be here as a member of the British Society of Naval Architects and to see how very lively these meetings are and how much energy there is in this society.

Capt. William Hovgaard—Mr. Reid must have misunderstood my remarks on the monitor type. What I intended to convey was that the monitor is not such a useless and obsolete type as thought by many people. When turned to its proper use it may still prove valuable even in a country which, as the United States, has a powerful seagoing navy. I did not recommend the construction of such ships at the present time; whether this would be expedient or not depends on the general scheme of national defense, with which I am not acquainted, but conditions could easily be imagined under which it would be desirable to entrust the defense of distant possessions, notably the Philippines, to monitors or monitor-like coast defense ships. As to the battleships, I stated that I considered a displacement of 18,000 tons as sufficient at the present moment. This is 2,000 tons more than the displacement of any battleship so far laid down in this country. I also recommended the adoption of several novel features: Turbines, liquid fuel by mixed combustion and small tube boilers, and finally a speed equal to or in excess of the speed of all existing battleships of the United States navy. It is difficult to see wherein these features Mr. Reid finds the retrograde move, which he deplores. As to the use of 9-in. or 10-in. guns for intermediate battery, with 12-in. guns as primary battery, it is my belief that this combination is more efficient than if the same weight had been put in a uniform battery of 12-in. guns. It is a point on which opinions differ, also in England, and Mr. Reid's verdict that this should be a retrograde step is at least open to question.

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of spaces, but closer pitch on the doubling plate.

The rake is 1¼ inches on the foremast and 1¾ inches on the main mast, and Figs. D and E show the method of obtaining the cut of the bottom plates of the mast.

A, B, C, D, Fig. 142, represents the bottom of mast cut off at A B at right angles to the center of the mast.

The lap of the plate is shown at L and the half circle A, 5, 4, 3, 2, 1, and B is the plan through A B.

On the half circle A B the line is divided up in six equal parts which gives the lines 5, 4, 3, 2 and 1 being $29\frac{7}{16}=4\frac{29}{32}$ inches. These lines are drawn parallel to A D, which intersects the bottom line of mast C D.

Fig. 143 represents the expanded plates for the bottom of the mast and the true form of the shape of same where it rests on the deck or step.

The expansion is obtained by bending a batten around the half circle A 5, 4, 3, 2, and 1 and B and copying these points on it. The line A B, Fig. 142, is extended long enough to get in the lines A, 5, 4, 3, 2, 1 and B, which are $4\frac{29}{32}$ apart and at right angles to A B, Fig. 143. The batten is applied to the line A B, Fig. 143, and the marks for lines put on the floor which are drawn parallel to B C, Fig. 142.

To obtain the shape of line D C, Fig. 143, the distance from A B Fig 142, to the intersection of the line D C is measured on a batten and transferred to Fig. 143 as shown by tracing the lines from Fig. D and E, viz: D D, 55, 44, 33, 22, 11 and CC which completes the half of the mast at bottom to the depth of B C.

Fig. 143 shows the bottom of the mast A B C D expanded. It is only necessary to develop the half of the plate on each strake as the mold for same can be turned over for the other half.

Masts which are built flush and butt strapped are treated as three cylinders one fitting into the other. The strap of the outside plate will butt up against the seam of the inside plate and the same pitch of rivets will do for both the strap and inside plate at butt. The strap for the inside plate will require to be the thickness of the mast plate less in radius so that the pitch of rivets will require to be closer to retain the same number of holes. Angle rings on the masts require a little different consideration than the plate.

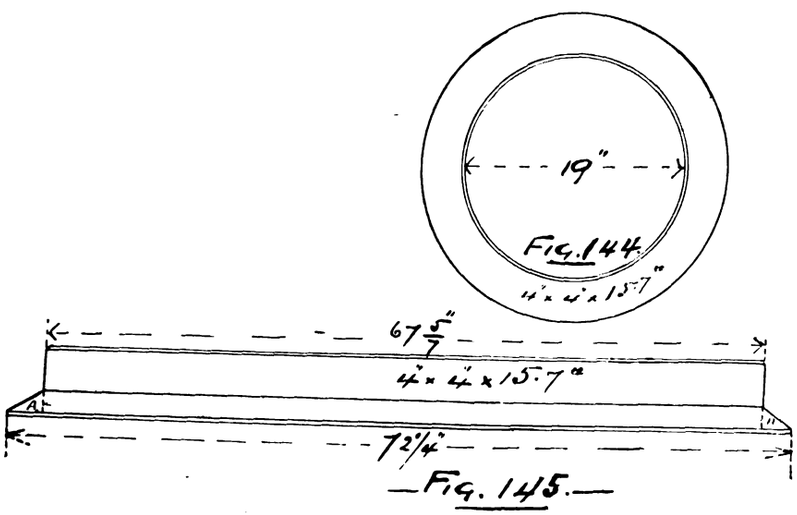

Fig. 145.

Fig. 144 shows a ring 4 in. x 4 in. x 15.7 in. angle, to get the length of this ring the diameter of the ring is multiplied by 3¼ and twice the width of the flange added to same. Example:

$$\frac{19\times22}{7}+8=67\frac{5}{7}$$

Fig. 145 shows the length of angle necessary to make this ring. So that the outside of the flange will be long enough when bent for the ring to have a close fit the difference between a circle 19 and 27 inches must be obtained. This is done by adding the width of the flange to the diameter and using the same rule for the length. Example: $\frac{19+4\times22}{7}=72\frac{2}{7}$ equals length of flange outside.

$72\frac{2}{7} - 67\frac{5}{7} = 4\frac{4}{7}$ the difference between the standing and horizontal flanges as shown at A Fig. 145 when a number of rings are to be made they usually bend one-half of a ring and find out if the calculation is correct. For an inside angle ring once the flange must be deducted before using the calculation 3 1-7. Less material is required for a small ring than a large one, and less material for a ring turned at the fire than at the furnace where it is bent in one heat.

In Scotland all the mast plates are piled up for each strake beginning at the bottom, number one plate. The plans supplied give the length and width of plates and diameter of mast at each butt on each strake. Battens with a universal pitch of rivets of 5 diameters are made and applied to the line obtained from the plan for the edge of the plate. The lap butt holes are divided up with compasses the same number of holes being punched in the plates which come together. Plates which may be longer at the ends the batten is moved along so that the desired number of holes may be obtained to complete the plate.

The process of laying out the masts is to raise the plate on the top of the pile enough to get the clip on the plate for holding the lap strip in place until all the rivet holes are marked.

A center line is put on the plate similar to Fig. 141 and the butts squared in with a steel T square, also the half length of the plate where the plate may be slightly curved on the edge if there be much taper to the mast.

The batten is held to the marks put on for the width of the plate and all the rivet holes marked, then between the lap holes the butt cap holes are divided off with compasses, the same number of spaces being in both ends only the smaller or inside plate having the rivet holes closer together. The plate when marked being similar to Fig. C.

When masts are flush with butt straps the straps are all punched and when the plate is squared off the inside of the strap is lined in on the plate and the strap held to same. For the difference in length of the butt strap and width of plate the strap is moved slightly from the center of the plate so that the end hole will be in its place when the strap holes are marked. If there is any doubt about making allowance for the one plate fitting into the other, either in this country or Scotland, a piece of plate is punched and bent to the outside diameter then a piece of plate is bent for the inside fitted marked and punched and on straightening the plates out and putting them together the proper location of the rivet holes will be found. To mark, punch, roll and put together in Scotland the plates and rings of masts like Fig. 139 would cost $72, while on the lakes they cost only half of that.

The steamer Hugh Kennedy, building at the Lorain yard of the American Ship Building Co. for Capt. John Mitchell, of Cleveland, will be launched on Saturday next. This steamer is of the 10,000-ton class, being 552 ft. over all, 532 ft. keel, 56 ft. beam, and 31 ft. deep. She will be commanded by Capt. Charles B Galton, of Algonac, Mich.

The barge Iron Cliff has been sold by Corrigan, McKinney & Co., of Cleveland, to Capt. J. C. Pringle, St. Clair, Mich.

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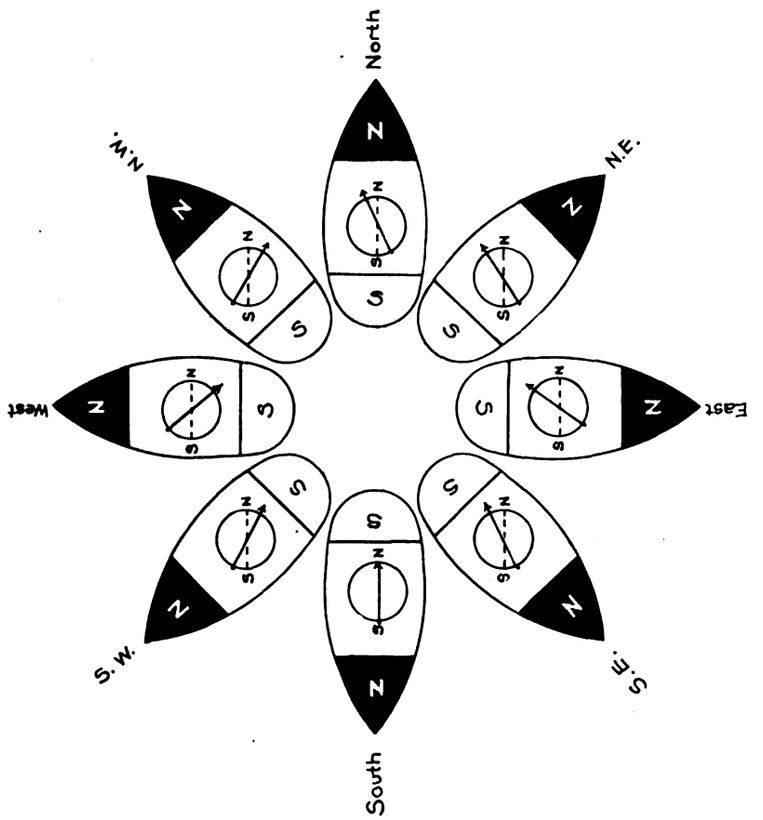
SCIENTIFIC LAKE NAVIGATION

By Clarence E. Long

SHIP BUILT HEADING NORTH.

Your attention is now called to Fig. 4 which shows the natural deviation of an iron or steel vessel supposed to be built with her head correct magnetic north in a north magnetic latitude, and which also shows the same vessel heading on the eight principal points of the compass, and the manner in which the compass needle is affected in each case. The dark or shaded portion shows north magnetism of a fixed nature developed in the bow and south magnetism in the stern; hence the vessel represents a huge magnet with its north pole at the bow and its south pole at the stern. Now taking the case of the ship built with her head north correct magnetic, the fore part of the ship has acquired north (red) magnetism, and its action will be precisely the same as that of the north pole of a magnet; hence on northerly courses, the north end of the compass needle will be repelled, and the directive power of the needle diminished. On southerly courses the north end of the needle points towards the stern, which has acquired sub-permanent south magnetism, then the directive power of the needle is increased. On easterly and westerly courses the effects on the compass are greatest, since the force acts at right angles to the needle; and on all intermediate positions of the ship's head the disturbance due to such positions are intermediate. As the ship's head is brought east of north, repulsion of the north end of the needle takes place, and westerly deviation is the result, and it reaches its maximum value when the fore-and-aft line of the ship is at right angles to the needle; beyond that position the fore part of the ship attracts the south end of the needle, and westerly deviation is still the result. This attraction continues until the ship's head reaches south, when the line of action of the ship lies in the same direction as the needle, and no disturbance occurs, but the directive power of the needle is greater. On bringing the ship's head round west of south, the south pole of the needle still continues to be attracted, which causes easterly deviation, and it again attains its maximum when the fore-and-aft line of the ship is at right angles to the disturbed needle; this must occur to the north of west. After that point has been reached by the ship's head, the fore part of the ship repels the north end of the needle, easterly deviation still being the result until the ship's head is again at north. Thus we find in a ship of this kind as her head is moved in azimuth round an entire circle the disturbance of the compass is little or nothing when her head is on or near the points to which her head or stern were directed while building, and that between these two points are two semi-circles, in one of which the deviation is westerly, and in the other easterly, and is greatest in each case when the ship's head is directed to the points of the compass that were abeam while on the building slip. For an observer to suppose himself standing in the center of the compass looking towards the direction of the ship's head when building, the semi-circle to the right of him would have westerly, and that to the left easterly, deviation.

As has been seen in the case of a vessel built heading north that the deviation gradually increases until the vessel's head is at either east or west (right angles) at which points it attains its maximum, or greatest amount; westerly deviation occuring in the east-



Showing the sub-permanent magnetism of a ship built heading North. The eight figures show the same ship heading on the principal points of the compass. The directions are magnetic. The circle represents the compass on board and the dotted line (diameter) passing through it and marked N S shows the direction of magnetic north and south. The straight line with the arrow-head at one end and feathered at the other represents the compass needle; the arrow-head being N and the feathered end S. If there is no deviation the compass needle should coincide with the magnetic line, the same as the ship heading south in diagram. The distance (in arc) the compass needle is drawn aside from the line marked N S is the deviation. Bear in mind that the compass needle carries the compass card and whichever way the needle is drawn the card moves the same way. The deviation is Ely. when the needle is drawn to the right of the magnetic meridian, and Wly. when drawn to the left of it.

The heavy or shaded portion of diagram represents north magnetism, or of the same kind that is in the north end of the compass needle, and the light portion represents south magnetism, or the same kind as the south end of the needle contains. N and N and S and S cause a repulsion of the compass needle, while N and S or S and N cause an attraction. Either an attraction or a repulsion may cause Ely. or Wly. deviation depending on the conditions under which they take place; thus, the same magnetism that causes a Wly. Dev. heading East, causes an Ely. Dev. heading West.

In the case of the ship heading North in the above diagram, the compass needle is shown deflected to the left, or westerly deviation. It could be easterly under the same circumstances. The compass needle might as likely have been repelled to the right as to the left. It must be understood that this but represents a particular case.

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ern semi-circle of the compass and westerly in the western semi-circle. For a boat heading south under the same conditions the opposite effects would be the result, the compass needle would be deflected to the right, or easterly, in the eastern semi-circle, and to the left or westerly, in the western semi-circle. In the case of a vessel heading east or west while building the points of maximum deviation and minimum deviation would be the opposite of those built heading north and south. The poles of the ship would be athwartships and the neutral, or separating line, would run through the center of the vessel in a fore-and-aft line. In the case of a vessel heading east while building the north pole of her magnetism would be to port and the south pole to starboard. In a vessel heading west while building the condition would be reversed.

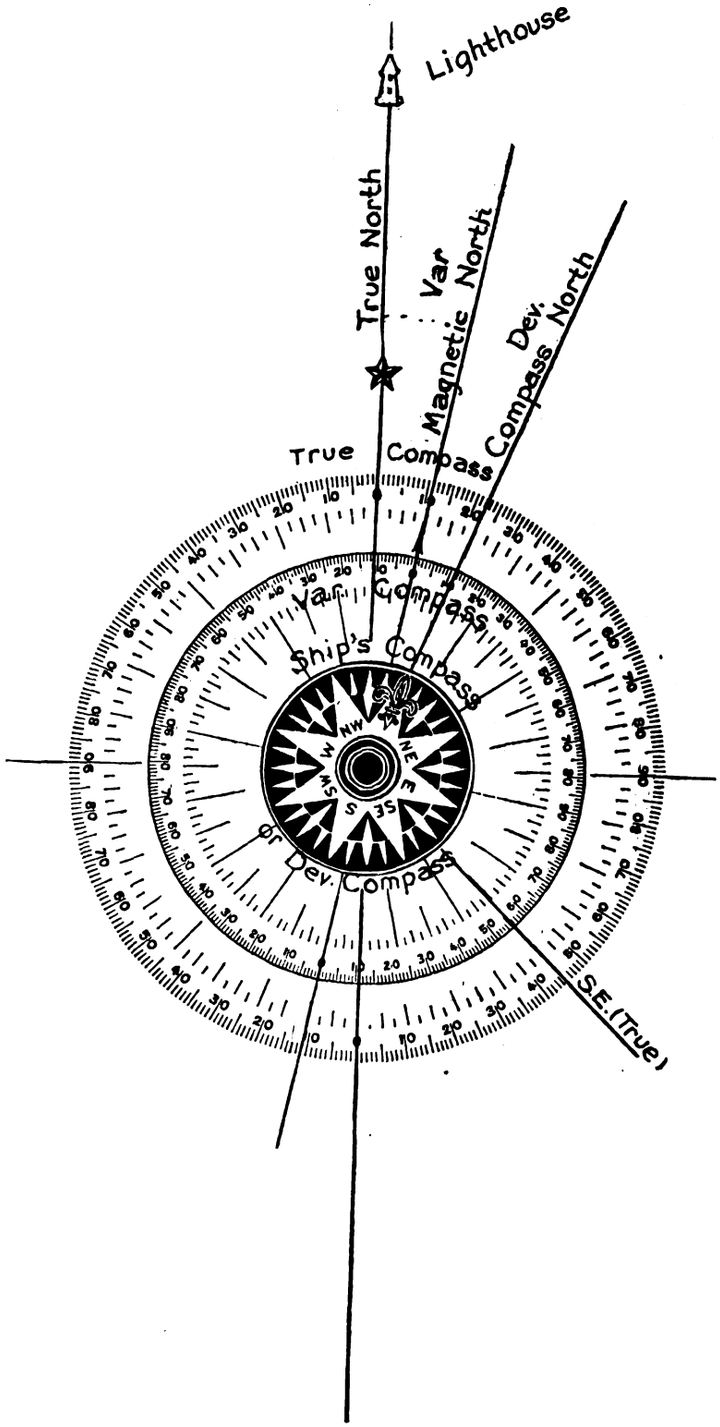
Endless diagrams might be drawn to show these various effects and conditions with the direction of the ship's head at time of building and as she is conned in different directions, on her subpermanent magnetic character. The student having mastered the principle, can draw for himself any special case he may desire, and it goes without saying that this is one of the best methods that the student could pursue in order to acquire a clear and comprehensive knowledge of the ship's magnetism and what it will do under any and all conditions.

We will have done with the causes and effects of magnetism for the present, and will take up the subject of allowing and applying the deviation in order to steer the (corrected) compass course, i. e., the application of the deviation to the correct magnetic course to obtain the compass course and vice versa. How to find the deviation by all the known methods, and how the deviation is resolved into its constituent parts will be explained in chapters to come.

THERE IS NO DIFFERENCE.

The deviation is measured from the magnetic meridian, that is, the angle north on the card makes with the magnetic meridian, or the distance the card is turned away from the magnetic meridian.

When the variation is applied or allowed to the true north it gives the direction of correct magnetic north, though on the compass card the direction will be something else besides north. Thus the Var. is 1 point Ely., true north will be pointed out by N by W on the compass. Now, supposing that on the chart there are two lighthouses in range, the true bearing of which is north, and for their location the Var. is 1 point Ely., hence the correct magnetic bearing of these lighthouses in range is N by W, which means that if there were no deviation on this point of the compass the compass would read N by W when the vessel's head was brought in the same line with the lighthouses. Now, supposing that when the vessel's head is in range with the lighthouses the compass showed NNW instead of N by W; then the difference in these two directions (the angle) is the deviation, because the variation has been allowed for, or in other words it has been taken out or deducted and therefore does not enter into the problem so far as the deviation is concerned.



Showing both Ely. Var. and Dev.—one point each.

Note.—Magnetic north, or correct magnetic north; magnetic meridian or correct magnetic meridian; magnetic needle (on the card) are, in this lesson, used indifferently to mean the same thing.

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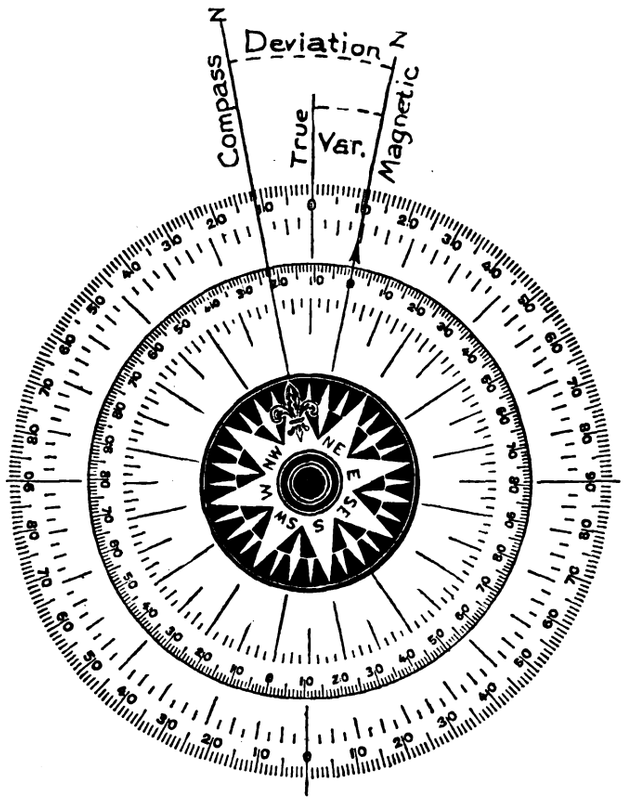
The deviation in this case is measured from the correct magnetic north, which on the compass is N by W. The magnetic meridian in this case is shown by the compass to be N by E with reference to the true points of the horizon, that is, in case there were no deviation when the vessel's head was in range with the lighthouses. North on the compass (with no deviation) points out the direction of the magnetic meridian, and coincides with N by E true, and the bearing of the lighthouses by the same compass is N by W, which coincides with north true.

The deviation in the foregoing example is one point easterly, the same as the variation.

Now we'll measure the deviation from the magnetic meridian proper and show the same thing. The magnetic meridian is measured from the true meridian (i. e., the angle it makes with true north and south.) In this case the angle is one point and being easterly, it is to the right of the true meridian, hence the magnetic directions of the compass card are to the right just that much. Hence, true north is shown by N by W on the card, and north on the compass points out the magnetic meridian, or directly to the north magnetic pole.

Now, if we take a bearing and find that NNW is where N by W ought to be we have another point of deflection, or the Var. and Dev. combined equals 2 points. We know that the Var. is equal to 1 point so that the difference must equal the deviation, or NNW is two points from north. The Var. applied in the first place gives N by W, and the difference between N by W and NNW is one point, or the amount of the deviation. See diagram following.



Showing 1 point of Ely. Var. and 2 points of Wly. Dev. Since the Var. and Dev. are of different names, their difference equals the amount that the compass is "off" from the true directions—one point Wly. in this particular case.

Variation is the difference between True North and Magnetic North. Deviation is the difference between Magnetic North and Compass North. Var. is measured from the true meridian to the magnetic meridian. Deviation is measured from the magnetic meridian to the meridian of the compass. The difference between a true course or bearing and a correct magnetic course or bearing is the Var., and the difference between a correct magnetic course or bearing and a compass course or bearing is the Dev. The difference between a true course or bearing and a compass course or bearing is the Var. and Dev. combined.

Moving over the circumference of the compass card in order to counteract the effects of variation eliminates this quantity from the problem entirely, so that whatever the difference between what we know the correct magnetic bearing to be and the bearing as shown by compass equals the deviation on that particular point to which the ship's head was steadied at the time of observation.

Whether measured from the magnetic or the correct magnetic, it amounts to the same thing, since when the Var. is taken out, the difference must be the deviation. Here is another example: Set up your compass on shore in a place free from local attraction of any kind. Then run a north and south line by compass (magnetic) by means of a chalk line. To do this it takes three persons. Have about 50 feet of line with a person on each end of it. Bring the line over the center of the compass so that it exactly coincides with the north and south points on the card. To do this accurately requires a good deal of maneuvering, and the third person must keep tab on the compass and direct the movements of the assistants handling the chalk line. When the cord is exactly coincident with north and south erect a batten at each end of the chalk line. See that the battens set plumb, and when completed you have a north and south magnetic range. You can increase the distance between the battens by continuing the line as above described. If you have a Pelorus, or an Azimuth attachment (an instrument carrying sight vanes for the taking of bearings—the same as a surveyor's outfit), it becomes an easy matter to run this line by setting the sight vanes in the direction of north and south by compass. If you have a Pelorus set its box square with the box of the compass, on either end or on either side, it makes no difference; set the Pelorus dial with that of the compass and clamp the sight vanes to these points; if you have the sight bars set them to north and south on top of the compass. Then sight through, having an attendant to erect the battens according to your instructions. By this method the greater the distance (so long as you can see distinctly) the more accurate is this line. To get the back line for the range sight through the vanes the reverse way. This is the method employed by surveyors.

Now, if you place your boat on this range, and the compass reads anything but north, the difference is the deviation. We do not even have to know the amount or the direction of the variation, since we know that a compass in a place free from magnetic disturbance of any kind except that of the earth's magnetism which gives it the power of pointing, shows magnetic directions of the horizon, or in other words north on the card points to the magnetic pole, or points out the magnetic meridian of the place. Then the difference as shown by the compass on board and what we know the compass to show on shore is the deviation. We will say in the above example the variation is one point

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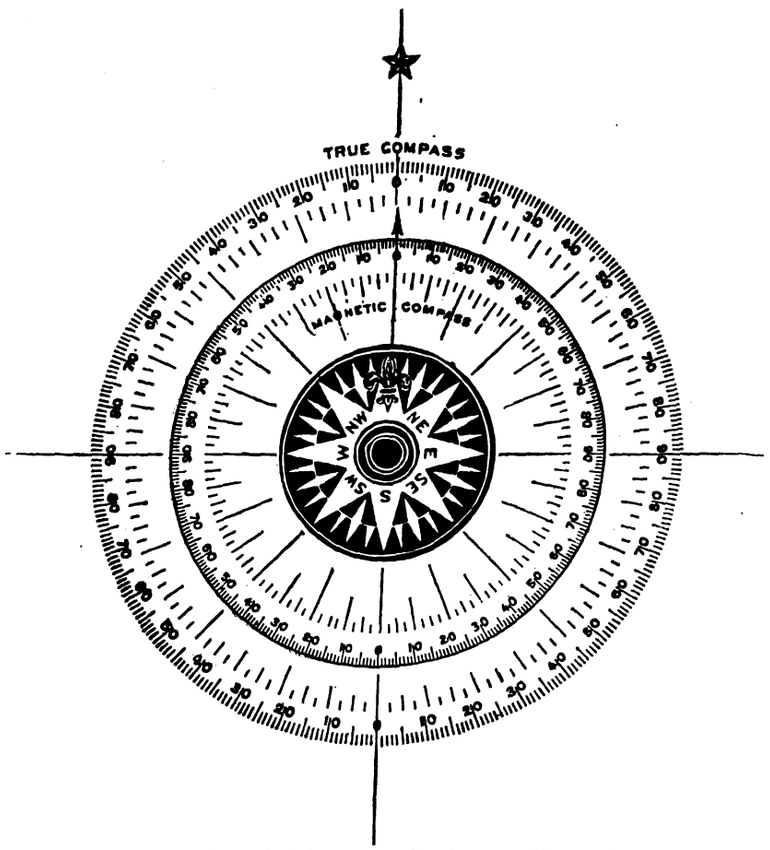
easterly. Then the range of magnetic north would have a true bearing of N by E, since the true directions corresponding to the magnetic directions are to the right. The rule says to find the true bearing from the magnetic or correct magnetic bearing, allow easterly variation to the right of the magnetic or correct magnetic bearing, and westerly to the left. Now, one point to the right of north magnetic gives N by E true. From true to magnetic or correct magnetic, easterly variation to the left, and westerly to the right; hence the true bearing N by E, Var. 1 pt. Ely., magnetic or correct magnetic bearing north—1 point to the left of N by E.

To prove again that there is no difference between magnetic and correct magnetic when the variation has been allowed for—taken out. The true bearing of a range is SE true. To start with there is neither variation nor deviation. Head your vessel north (true) by compass and lay across the range so that when you are in line with the range your compass reads SE. Now, imagine your boat to be perfectly stationary heading north by compass and the range bearing SE by the same compass. While in this position imagine your compass to be affected by one point of easterly variation; that is, the card has swung one point to the right of its former position. Then your boat will be heading N by W by compass, and the bearing of the range is SE true with one point of easterly variation the correct magnetic bearing would be SE by E, and to head by compass in order to bring this range SE by E, you would have to head N by W, thus allowing for the variation. When the compass swung for the amount of the variation it corrected itself, on the same principle as taking the course off the chart from the magnetic rose instead of the true rose. Now, if there were any deviation on N by W the correct magnetic bearing of SE by E would show something else than SE by E on the compass when you took the bearing. Whatever it is it would be the difference between what you know the correct magnetic bearing (SE by E) to be and what the compass says. The deviation, remember, would be for that point of the compass on which the vessel was heading and not for that point of the compass corresponding to the bearing. Bear this in mind.

Showing both Ely. Var. and Dev.—one point each. True north coincides with N by W magnetic or correct magnetic. North magnetic or correct magnetic north, coincides with N by E true. That point of the compass (the ship's compass or deviation compass) that coincides with true north is NNW and N by W on the Var. compass. It must be borne in mind that every compass is subject to variation if in a place where variation exists, and to deviation if within the disturbing influences of iron and steel of the ship which gives rise to deviation. The three compass diagrams indicate the manner in which the compass is subjected when affected by variation and deviation. These diagrams indicate a compass in three conditions in respect to direction. The first condition (indicated by the outer circumference) represents the true directions of the compass and they never change as do the Var. and Dev. compass. It is from this outer circumference that all true directions are first taken. These true directions are the same for all places on the earth. If a compass is free from both Var. and Dev. then the points at the circumference of its card will point just as they do on the card of the outer circle; or in other words, the compass indicates true directions. It is seldom the case that a compass is free from both Var. and Dev. It may be free from one or the other at times but hardly ever from both Var. and Dev. at the same time. This is because the variation depends upon the locality the ship is in, and as there are only a few places on the earth where there is no variation, hence, it is seldom that a ship is where there is no variation.*

It is different with the deviation, which influence is caused by the disturbing effects of the iron and steel within the ship herself, hence, there may be different headings of the ship where there is no effect, or in the case where adjusting has freed the compass from deviation. It is not often the case that a compass is entirely free from deviation even after careful adjustment, and even if so it would not stay very long in that condition.

When the ship is in a locality where variation exists the compass card with its points is slewed so that they do not coincide with the points of the compass indicating the true horizon. The second circumference, marked "Var. Compass," in the foregoing diagram,



Showing no variation and no deviation. True N., Magnetic N. and Compass N. coincide with one another. Since there is no angle between the three norths, there can be no deflection of the needle.

Note.—We have used north in these examples in order to simplify matters, but remember that the rule applies to any point of the compass as well.

*Note.—This is possible along the north shore of Lake Michigan, and also north of this on Lake Superior (the line of no variation), where the variation is practically nothing. A compass then free from deviation would show true directions, the same as that of the outer circumference in the foregoing figure.

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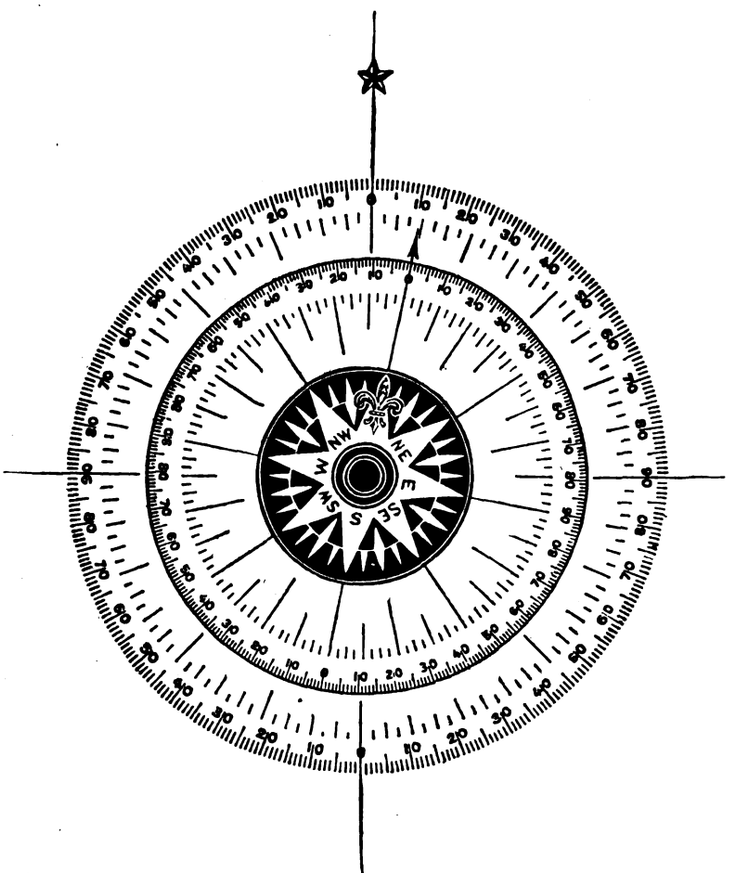
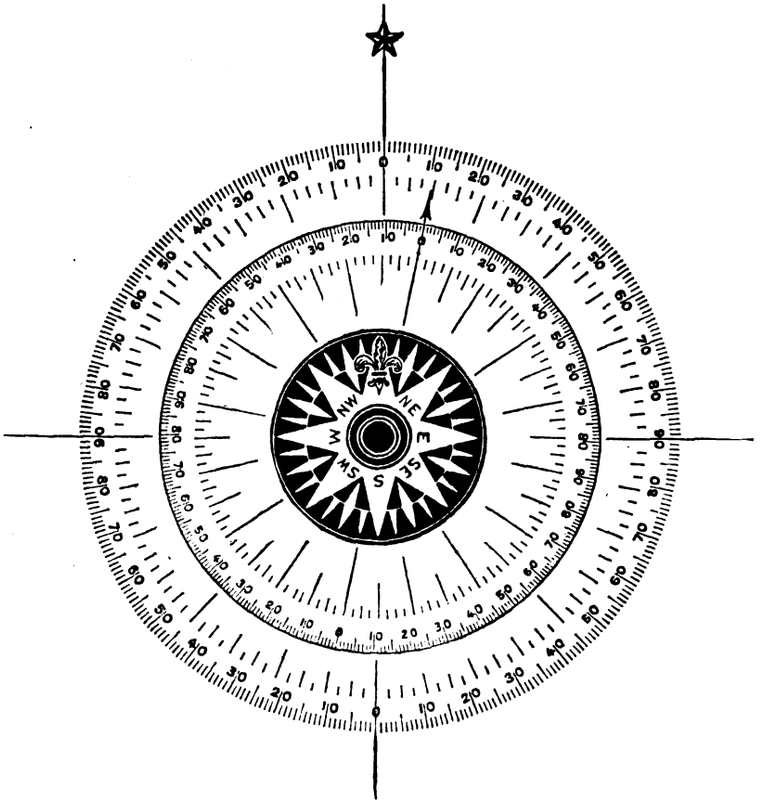


Showing no deviation, since magnetic north and compass north coincide with each other. The Var. is one point Ely. because magnetic north is one point to the right of true north.



Showing one point of Ely. Var. and one point of Wly. Dev. The compass points true in this case, because the Var. and Dev. being of the same amount are opposite in name, one counteracting the other; nevertheless, Var. and Dev. exist. One not acquainted with these facts might be led to believe that there was neither Var. nor Dev.

represents this, though it represents but a particular case. The variation compass merely indicates, for a given locality, how the compass points in comparison with the true compass. It is then necessary to know on the variation compass where the true points of the horizon are to be found. If the variation is known this is easily done by allowing the amount to the direction to be taken.

The inner diagram compass, marked "Ship's Compass or Dev. Compass," represents the compass on board under the influence of both Var. and Dev. Where a compass has deviation the north and south points of the card (the needle) is turned away from the magnetic meridian; that is, the north and south line of the compass card does not coincide with the magnetic north and south line of the locality the ship is in. The magnetic meridian is different for different places while the true meridian is the same for every place.

On board ship the sea compass or mariner's compass, takes the place of the three compass diagrams shown above. If it were possible to have compasses on board to show separately the three circles of direction as above, navigation would be greatly simplified. Therefore, any compass on board must answer these three purposes, and this is where the navigator must show his ability as a navigator to make the one instrument answer the purpose of three. He must know how much his compass is effected by variation and deviation. He must know the deviation for every course he steers, and also the variation for the different localities he sails. Knowing these amounts he is able to find on the compass card, by making the proper allowances, the point or fractional point or degree, that is equivalent to the true direction he desires to steer his ship in.

Thus, in the above diagram with a point each of Ely. Var. and Dev., if it were desired to steer SE true by ship's compass the ship's head would have to be kept on the point ESE in order to do so.

ILLNESS OF W. C. McMILLAN.

Mr. W. C. McMillan, president of the Detroit & Cleveland Navigation Co. and the Detroit & Buffalo Steamboat Co., is dangerously ill at Detroit, his life being dispaired of by his physicians.

Mr. Charles H. Keep, formerly secretary of the Lake Carriers' Association, has been appointed bank superintendent for the state of New York.

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QUESTIONS FOR WHEELSMEN AND WATCHMEN.—NO. 28.

282. Supposing you intended to anchor under Grand island and while running in on the ranges, from the west side of the island the weather set in thick and shut in the ranges from view, how would you pilot your boat in safely?

283. With stern on your boat on upper St. Mary's river ranges your steering compass reads NWxW½W, how would you steer with same compass and boat in same trim from a point two miles N of White Fish point lighthouse to a point one mile SWxS½S from Passage island lighthouse?

284. With stern of your boat on Bernard ranges your steering compass reads NW¼N, how would you steer with same compass and boat in same trim from a point two miles north of White Fish point lighthouse to a point two miles south of Battle island lighthouse?

285. With stern of your boat on Neebish island ranges your steering compass reads NWxN¼N, how would you steer with same compass and boat in same trim from a point two miles north of White Fish point lighthouse to a point four miles SE½E from Michipecoten island lighthouse?

286. Give correct magnetic course and distance from a point two miles north of White Fish point lighthouse to the entrance of Michipecoten harbor.

287. Give correct magnetic course and distance from a point four miles north of Eagle harbor to Two Harbors.

288. How would you pilot a boat from Ashland to Duluth?

289. Where is the deepest sounding found on Lake Superior?

290. Describe the general appearance of the land on both sides of the river from Sault Ste. Marie to Point Iroquois.

QUESTIONS FOR MASTERS AND MATES.—NO. 27.

400. If the deviation is easterly with the ship's head east, what name will the deviation have with the ship's head west.

401. Why is the deviation easterly in one semi-circle of the compass and westerly in the opposite semi-circle?

402. If the deviation was of the same amount on north as on south, and when the ship's head was north correct magnetic the compass read N by W, what would the compass read with the ship's head south correct magnetic?

403. State approximately the location of the magnetic poles in the hull of a steel boat built at Cleveland with her head north correct magnetic while on the stocks?

404. What would be the position of the poles if she were built heading NE at Cleveland?

405. Is the magnetism of the hull of a ship separate from the equipment, such as the boilers, engines, funnels, spars, etc.? Why?

406. Knowing the direction and the place of building of your boat, will you be able to tell the kind and name of the deviation existing? Or, is it also necessary to know the magnetic effects of the equipment?

407. Why is it that the compasses of steel boats are different in the spring than they were the fall before.

408. Why is it that the same compass shows a different deviation in the same hull when the vessel is light than when loaded, or anything between light and loaded?

409. How many different kinds of magnetism are there causing deviation; or in other words, how many kinds of deviation are there, and what is the cause of each?

410. State how you would place the magnet to adjust the compass on north and south, and on east and west?

411. If there was then a remaining deviation on NE, how would you adjust it?

412. If your compass was under the effects of heeling deviation, how could you detect it?

413. Bound up the Soo river your compass reads SW⅜W when in range with Pt. au Pins, how much and which way is the deviation?

414. Bound up the Soo river, how would you determine your compass course from Devils island to Duluth?

MARINE PATENTS.

Copies of these patents can be obtained by sending ten cents in stamps to Siggers & Siggers, patent lawyers, suite 11, National Union building, Washington, D. C.

841,243. Propelling Device for Steam Vessels. Joseph Greaves, Radersburg, Mont.

841,452. Boat Propelling Mechanism. Robert Rutherford, Montaville, Oregon.

841,580. Aerial Transportation System for Vessels. George G. Schroeder, Washington, D. C.

841,583. Marine Electric Wharfage. Geo. G. Schroeder, Washington, D. C., assignor to Industrial Transportation Co., a Corporation of the District of Columbia.

OPPOSED TO DIVERTING MORE WATER.

The Cleveland Chamber of Commerce at its monthly meeting this week placed itself on record as opposed to the granting of a permit by the government for the proposed diversion of water from the great lakes to the Chicago Drainage Canal. The city of Chicago diverts at present through the Chicago river about 4,167 cu. ft. a second from Lake Michigan for sanitary purposes. It is now seeking to divert an additional 4,000 cu. ft. through the Calumet river. The International Waterways Commission made an extensive investigation as to the effect upon lake levels of any further diversion of water by Chicago, and concluded that a withdrawal of 10,000 cu. ft. per second would result in the lowering of the levels of the lakes and connecting channels of from 4¼ to 6¼ in., and the withdrawal of 14,000 cu. ft. per second of from 6 to 8½ in. The International Waterways Commission recommended that no diversion of water through the Calumet river should be permitted by the United States. In a brief address following the report, Mr. Harvey D. Goulder, said that 85 per cent of all the iron ore mined in the United States is transported along the great lakes, and that any reduction in lake levels would work an incalculable injury to the whole country. In fact, a modern steamer carries 100 tons of ore upon an inch of water, and invariably loads within an inch of the bottom in the connecting channels of the lakes. A reduction of 6 in. in average depth would mean a loss to navigation interests alone of $2,500,000 per annum, which capitalized at four per cent, amounts to a loss of $62,500,000.

ITEMS OF GENERAL INTEREST.

The department of Commerce and Labor has been officially advised that the Empire of Japan will recognize as valid the steamboat inspection certificates issued by the United States to American steamers, and will dispense with any further inspection as regards hulls, boilers, machinery and equipments, including life-saving apparatus, except such as is necessary to convince the inspectors that the equipment is as stated in the United States certificate. Hereafter, therefore, all passenger steamers to Japan sailing from ports in the United States and holding unexpired certificates of inspection issued by Japan will be subject to no further inspection.

Mr. Frank Waterhouse, of Seattle, Wash., has purchased the Pacific coast rights of the De Mayo coaling machine now in use on the docks of the American line, New York.

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FUTURE OF INLAND LLOYDS.

Buffalo, Jan. 22.—It looks very much as though the black-covered publication, familiar to all lake men for more than twenty years as the Inland Lloyds Vessel Register, had seen its last number. At least so it stands at present, for there is nobody to come forward and take it up when those who have supported it in past years turn their backs on it.

There was a meeting in Buffalo last week of the Inland Lloyds, President Gadsden, of Chicago, in the chair and a full representation of the various underwriting interests from Chicago to New York. It was time to see what was to be done for the coming season, as there must be a large amount of vessel inspection done if a new register was to be issued in March as usual. Commonly the republication of the register was a matter of course, so that the inspection could be taken up before this time, but it is understood that nothing has been done now and unless the position taken by the meeting last week is reversed there will be nothing done.

It is not claimed that a vote to discontinue was taken and such seems not to have been the case. The meeting simply failed to come to an agreement and adjourned It is possible to call another meeting, but it does not look as though it would be done, at least according to the view of a leading underwriter who was present. As often happens there was a variety of objections to the register, all managing to combine against it, though the objectors by no means agreed among themselves. There was the member who did not like the way the work had been carried on and there was the member who objected to the cost. Then there was the member who said that such expenses were borne by the insured everywhere but on the lakes and they ought to be here. When a vessel owner asked for insurance he was required to furnish rating and valuation that was satisfactory to the underwriter before anything could be done.

Such a state of things would be a bonanza to the private inspector, but the vessel owner would see in it a new reason for not insuring and the underwriters would no doubt lose in the end more than they had saved by not publishing the register. It is said that underwriters can buy a great lakes register and in the end they will probably do so if nothing else is done, though it appears that nobody really wants to depend upon that.

The fact is, as one underwriter says, that no register means no organization, no rate, maybe, and certainly no basis that can be called uniform. There is always a common rallying point possible from the basis of the Inland Lloyds even if there is usually nothing said of rates when the Lloyds meetings are held. The people are the same in both cases and it is easy to bring them together all along the line. There will be no common point at issue now.

Of course it was easy to lay the failure to agree on someone, though it may not be easy to convince the New York members that they spoiled an agreement by refusing to put up the funds needed for the register and the inspection. Maybe if it is stated that such is the report here they will come forward and go ahead, just to prove that they were not the ones who shut off an agreement.

At least it seems to be the wish of the Buffalo underwriters to go on as before and prepare the old basis for writing lake insurance. They see new difficulties likely to come up that may easily make the situation worse instead of better. So it appears to be hoped that another meeting may be held and the work taken up as before, though there is no sort of promise that it will be done.

There is nothing whatever done in regard to hull insurance for the coming season, though nothing very radical in the way of changes is looked for. The underwriters will hardly be able to make any concessions and they are not independent enough to exact any higher rates or less liberal form of policy. It takes a good season to make a good profit, in fact several such as last season to make up for the losses of one like 1905.

DEEPENING OF WELLAND CANAL.

Kingston, Ontario, Jan. 18.—For several years the leading marine men of Kingston have held that the only way for Canada to retain her grain transportation from the west to the seaboard, and to reduce cost of transportation, is by deepening the Welland canal. They urged this upon the grain and transportation commission, recently appointed by the Canadian government and lately the matter was taken up by the Kingston board of trade and an appeal was sent to all boards of trade in Canada urging immediate action. The replies received have been satisfactory, and it is expected that in March a large and influential deputation from all over the country will wait upon parliament, now in session at Ottawa and ask that the work of enlarging and improving the Welland canal be undertaken by the Dominion government without further delay.

Under existing conditions, the Canadian route via the Welland canal cannot possibly compete with that via Buffalo and New York. If the Welland canal is enlarged and improved so as to permit large vessels of the upper lakes to extend their voyage to the full length of deep water at or below the foot of Lake Ontario (Kingston) the larger haul of the large cargoes in unbroken bulk will place the advantage decidedly with the Canadian route. The comparative facilities will be:

By the New York route, a steamer of 10,000 tons for 900 miles to Buffalo, and a barge of 1,000 tons per 450 miles to New York.

By the Canadian route, a steamer of 10,000 tons per 1,100 miles to the east end of Lake Ontario (Kingston), and a barge of 2,000 tons for 170 miles to Montreal.

The comparative cost of transportation would be:

From the foot of Lake Erie—Buffalo to New York, including terminals, per bushel....		4.90 c
From the foot of Lake Erie, additional cost of steamer through improved Welland canal from Port Colborne to Kingston	.50 c	
Thence to Montreal by river barge including trans-shipment and all other terminals	1.625c	
Additional distance via St. Lawrence river...	.25 c	
	2.375c	2.375c
Balance of cost in favor of the St. Lawrence route		2.525c

The above comparisons establish the complete supremacy of the proposed improved Canadian route.

Robert S. Ellison, who was second mate on the City of Alpena at one time, has been appointed harbor master at Detroit to succeed Capt. W. H. O'Neil, who held the position for nearly a quarter of a century. Mr. Ellison was installed by Police Commissioner Smith, and is amply fitted for the place.

Edward R. Coleman of the Corinthian Yacht club of Philadelphia, has placed an order with Swasey, Raymond & Page of Boston, for an auxiliary three-masted schooner-yacht of the following dimensions: Length over all, 200 ft., length on load water line, 150 ft.; beam, 32 ft.; draught, 15 ft.

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